

DECEMBER 1962 35 CENTS

# Popular Science

Monthly

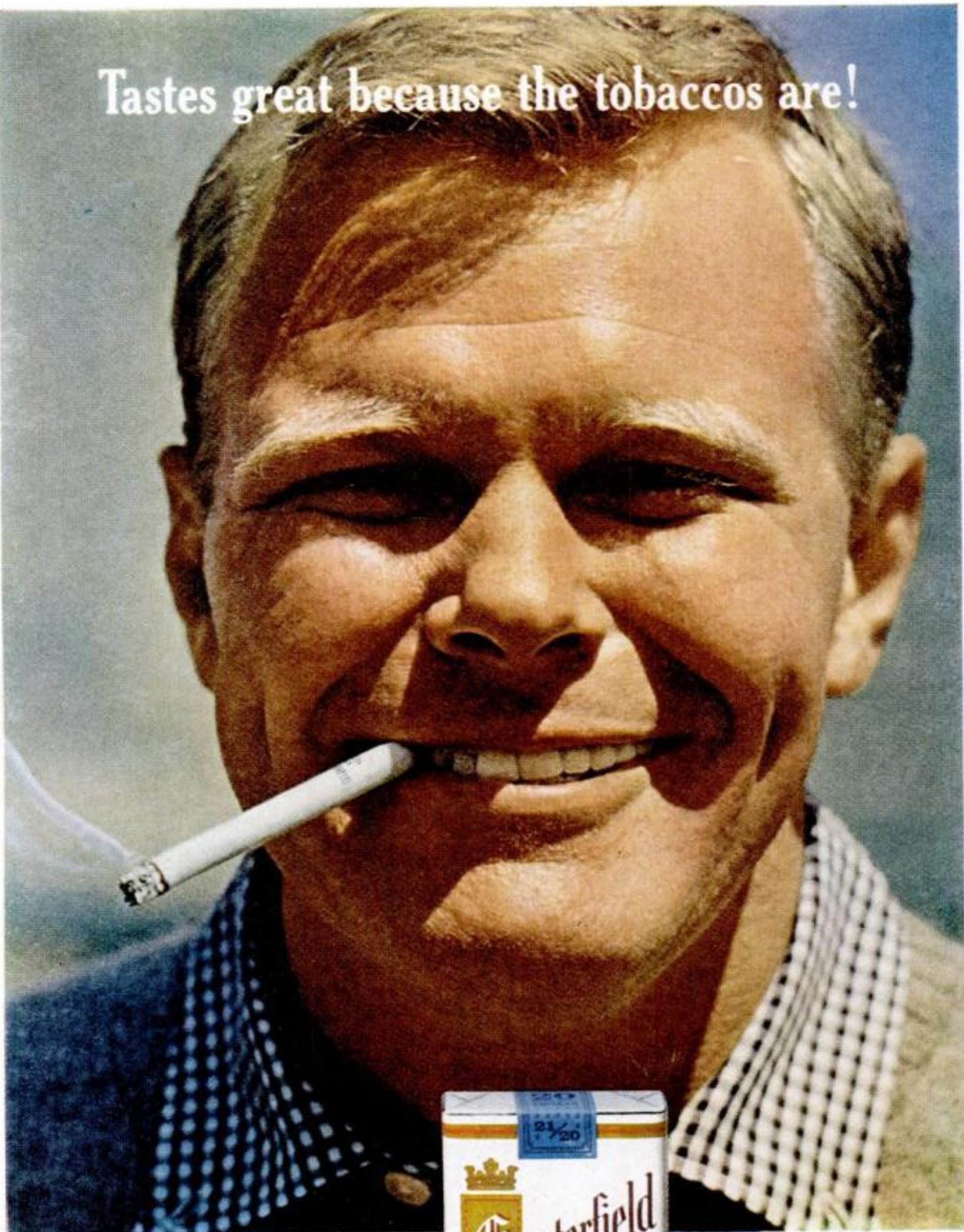
**Inside Our First  
Space  
Station**



**Extra:** *First Time Ever in a Magazine!*  
**TRY-IT-YOURSELF TEACHING-MACHINE LESSON**  
**Car Features:** *How to Install a Stick Shift—  
Transistor Ignition—Positive Crankcase Ventilation*



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20 WONDERFUL SMOKES!**

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**CHESTERFIELD KING**

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GENTLER,  
SMOOTHER  
TASTE

ORDINARY CIGARETTES

ENJOY THE  
LONGER  
LENGTH OF  
CHESTERFIELD  
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CHESTERFIELD KING

The smoke of a Chesterfield King mellows and softens as it flows through longer length... becomes smooth and gentle to your taste.



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**REVOLUTIONARY PATENTS DECREASE COSTS, INCREASE EFFICIENCY**  
Top quality full scale power tools of heavy duty 100% cast iron and steel. Streamlined design reduces weight, cuts material and production costs. Special patents provide added efficiency, accuracy, savings. Nothing left out but exp've gingerbread. Parts made, assembled, tested, packed in our own factories, shipped direct. No store profits to add to cost.

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KIT**

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f.o.b. factory

Wt: 12 lbs.  
If desired, for easier  
work alignment: RIP  
FENCE, \$3.50  
add'l.

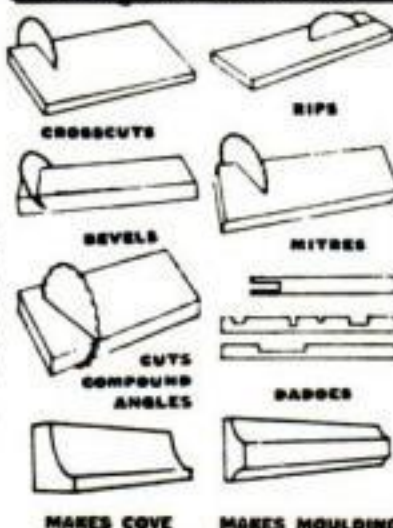


**KIT INCLUDES:**

- Complete blade carrying mechanism with depth of cut control • Ground spindle with saw flanges • Pre-oiled bearings • Angle of tilt control • Mitre gauge • Motor mount assembly • Attractive steel front control panel • All needed brackets, screws nuts, bolts • ABC assembly plans • Patterns for sturdy base, massive 20" x 24" table • Full instructions

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**IT'S FUN! IT'S EASY!** Save big money when you buy, save big money when you use. Use for 10 days. Put through most rugged tests. If not satisfied, return for full refund.

**6" SWING  
3-FT. LATHE**

**\$985**

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Optional Faceplate  
for turning bowls,  
trays, lamp bases,  
rosettes, etc.  
\$2.50



Complete as shown

**DOES THE WORK OF \$40 UNITS—**  
Sturdy all cast iron power tool turns wood or plastics with the precision and speed of machines selling for 4 times as much. Tubular steel bed, ball thrust cup center, spur center, T-Rest assembly, lever action tail stock, 2 speed pulley. Fits any motor.  
**UNCONDITIONAL 10 YR. GUARANTEE**

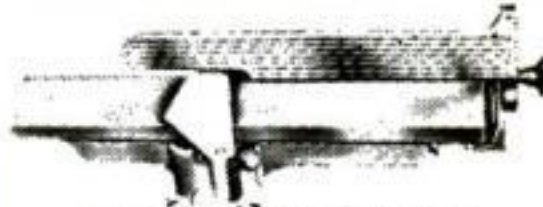
**FULL 22" LONG, 4 1/8"  
JOINTER-PLANER**

**\$1995**

F.O.B. Factory  
Complete as shown

100%  
precision  
ground  
cast iron  
and steel.

**PROVED BY  
MORE THAN  
500,000  
USERS**



**DOES WORK OF \$60 UNITS**

Now, at little more than a hand tool price, a guaranteed professional quality precision machine which does same work as skilled hand planing . . . much faster, more accurately. Make accurate glue joints; rabbeting cuts for doors, window frames, table drawers; square taper cuts for chair legs; accurate beveling.

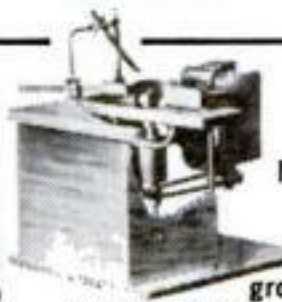
• Precision ground cast iron tables, adjustable for depth of cut • Rigid cast iron base • New patent-pending design holds clearance between knives and tables at any depth • Rabbet depth 3/8" • Hardened, ground high speed steel knives • Patent-pending fence adjustable to any position, any angle 0°-50° • Patent pending lift-off guard (nothing to loosen!) • Balanced steel cutter head.  
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BALL BEARING  
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optional—\$2.75



**DOES  
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UNITS**

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on furniture, forms  
beads, coves,  
moldings, tongue-in-  
groove joints, etc. A-B-C

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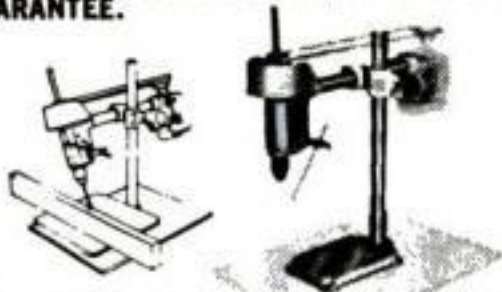
**UNCONDITIONAL 10-YR. GUARANTEE.**

**32" RADIAL  
DRILL PRESS**

**\$2995**

F.O.B. Factory  
1/2" Cap. Gear Chuck Inc.  
Shipping Wt. 30 lbs.

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OF \$90  
UNITS . . .  
AND A  
GREAT  
DEAL MORE**



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**December 1962**

Cover painting by  
Ray Pioch

Germany—March, 1945  
With the U. S.

and Russia closing in,  
who would get the  
rocket secrets of  
Peenemünde? Read  
how Dieter Huzel, on  
orders from Wernher  
von Braun, saved them  
for America. Page 67.



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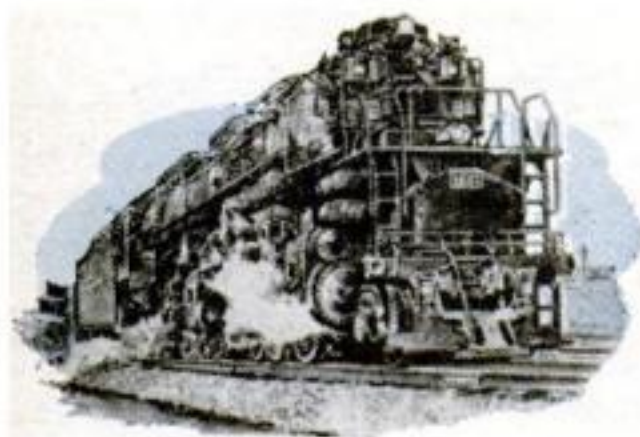
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Take a ride in the Scott 17.D.75 with  
PS Boating Editor Jim Roe. Verdict:  
It's got everything! Page 112.



A farewell salute to the Mallets  
—the iron monsters that cut our  
mountains down to size. Page 84.



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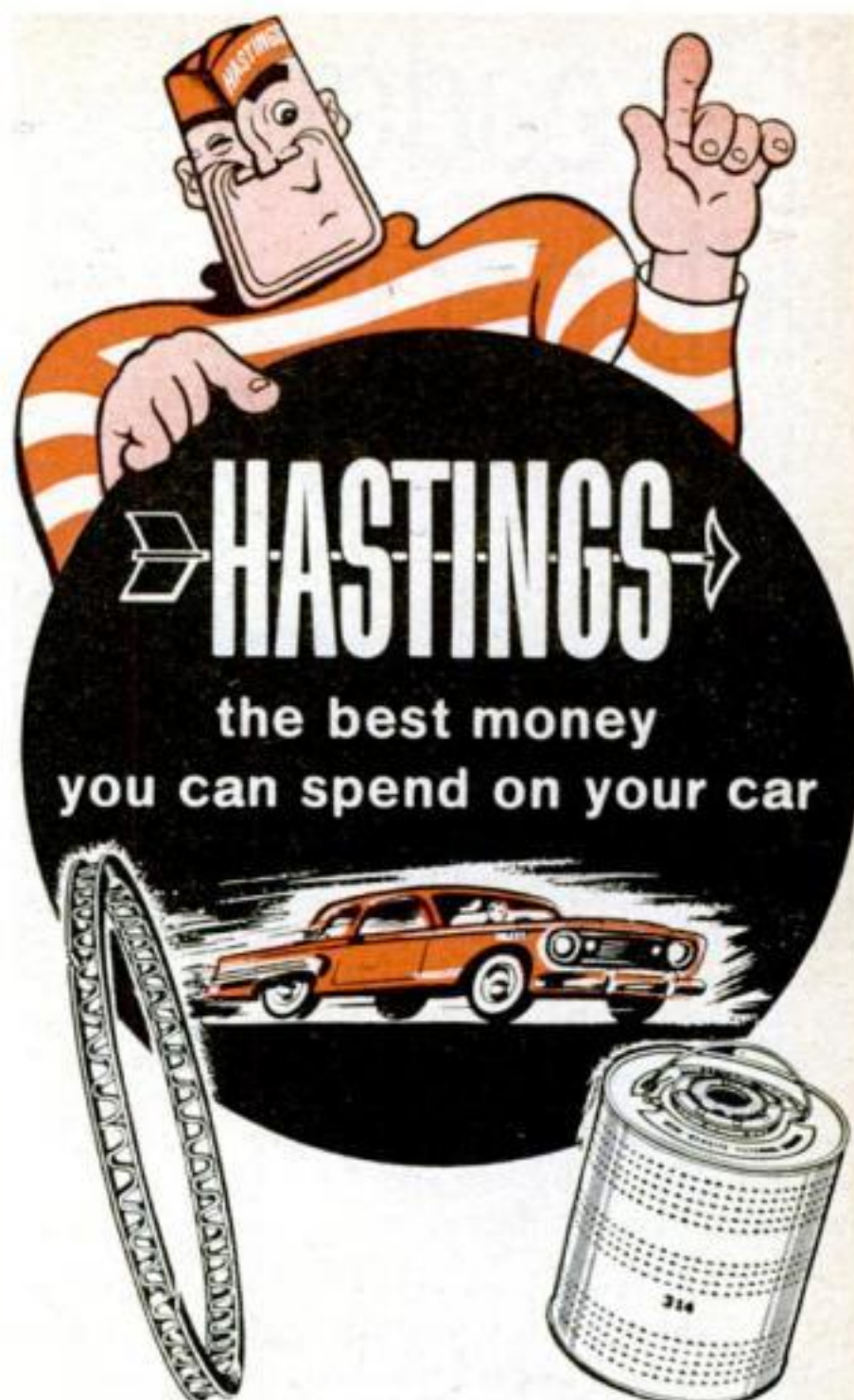
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# PS readers talk back



## That Aladdin's Lamp: the Laser

My hat is off to Mr. C. P. Gilmore ["The Incredible Ruby Ray," Sept.]. His technical explanation of the laser is detailed and clear—no fog factor. His tactful avoidance of confusion factors (such as the quantum theory of electron energy levels) effected a more meaningful understanding for a wider range of readers. My young son and I could discuss the laser intelligently after reading your fine article.

M. W. REITMEYER, San Jose, Calif.

... I think evidence points with little doubt to use of some laser instrument by the Russians. I think they've been using lasers for some time to knock out of the sky such machines as the U-2 plane.

G. L. DUPONT, Montreal, Can.

## Chopping a Way Through Bits

Thanks for "How to Chop Like a Champ" [Oct.] and especially for the illustration of the various axe bits. I had always thought that the "California reversible" was a "swamping axe" and vice versa.

The "Pacific felling" axe shown was made also with a straight double blade or "Sager" pattern. The long narrow blade was essential

in cutting the notches or board holes for the falling boards used as scaffolding to get above the swell butt of giant northwestern trees. Since the advent of the power chain saw, it is no longer necessary to climb the butt—the powerful saws whittle the tree down to size at ground level. I grew up on a ranch in Washington—a stump ranch with many huge stumps, relics of the old days of logging.

JOHN A. FLETCHER, St. Paul, Minn.

## Electronics Student Earns an A

I've just finished reading the report on the Knight-Kit tube checker ["Two Exciting New Electronic Kits," Oct.]. You say assembly time is about eight hours, but I built it in a little over 3½ hours. I found it quite easy to put together and the kit worked perfectly the first time I tried it. I'm taking a course in electronics, but I see no reason why construction time should be more than 4½-5 hours.

LARRY NARHI, Ashtabula, Ohio.

*Editor Gallagher did put the kit together in less than the eight hours mentioned. This was a conservative estimate of how long it would take a beginner.*

## One (Bath) for the Road

Talk about service stations! A friend of mine, just returned from Japan, tells me that over there customers are offered tea and hot baths



while their cars are being washed and serviced. Sounds like this "bath break" is just what some of our dozey Joes and drunken drivers need.

MARTIN LAVE, Bronx, NYC.

## Boating Angles

The elevators to keep a boat on an even keel ["What's New in Boating," Aug.] look like a

CONTINUED

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EDITORIAL OFFICES: 355 Lexington Ave., New York 17, N. Y.

PUBLISHED MONTHLY by Popular Science Publishing Co., Inc., 355 Lexington Ave., New York 17, N. Y.

SUBSCRIPTION SERVICE. *New or renewal orders:* Send to Popular Science Subscription Department, Boulder, Colo. One year \$4, 2 years \$7, 3 years \$9 in U.S., its possessions, and Canada. Elsewhere, 1 year \$6.50, 2 years \$12, 3 years \$17. Single copy 35¢. *Subscription orders processed electronically.* • *All subscription adjustments:* Write to Robert Harlan, Popular Science, P.O. Box 1083, Boulder, Colo. For change of address allow four weeks; please give both old and new addresses. Notices of undelivered copies (Form 3579) to Mr. Harlan. • *Second class postage paid at New York, N.Y., and at additional mailing offices.* Entered as second class matter at the Post Office Department, Canada. Printed in U.S.A. • *ADVERTISING OFFICES.* NEW YORK: 355 Lexington Ave.; CHICAGO: 360 N. Michigan Ave.; DETROIT: 2810 Book Bldg.; SAN FRANCISCO: 703 Market St.; CLEVELAND: 1220 Huron Road; LOS ANGELES: 1709 W. Eighth St.; PORTLAND, ORE.: 520 S.W. Sixth Ave.; DENVER: 333 W. Colfax Ave.





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- ☐ Interior Decorating
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- ☐ Sketching and Painting

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- ☐ Auto Electric Technician
- ☐ Automobile Mechanic
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- ☐ Transmission Specialist

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- ☐ Aero Engineering
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- ☐ Aircraft Mechanic

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- ☐ Accounting
- ☐ Cost Accounting
- ☐ Public Accounting
- ☐ Bus. Administration
- ☐ Executive Training
- ☐ Marketing
- ☐ Personnel-Labor Relations
- ☐ Programming for Digital Computers
- ☐ Purchasing Agent
- ☐ Real Estate
- ☐ Salesmanship
- ☐ Sales Mgmt.
- ☐ Small Business Mgmt.
- ☐ Traffic Mgmt.

### CHEMICAL

- ☐ Analytical Chemistry
- ☐ Chem. Engineering
- ☐ General Chemistry

- ☐ Lab. Technician
- ☐ Nuclear Energy
- ☐ Plastics
- ☐ Pulp, Paper

### CIVIL ENGINEERING

- ☐ Civil Engineering
- ☐ Construction Engrg.
- ☐ Highway Engineering
- ☐ Reading Structural Blueprints
- ☐ Sanitary Engineering
- ☐ Structural Engineering
- ☐ Surveying & Mapping

### DRAFTING

- ☐ Architectural
- ☐ Electrical and Electronic
- ☐ Mechanical
- ☐ Sheet Metal

### ELECTRICAL

- ☐ Elec. Appliance Servicing
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- ☐ Elec. Motor Repairman
- ☐ Industrial Electronic Technician

- ☐ Industrial Telemetering
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- ☐ Practical Lineman

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- ☐ Professional Secretary

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- ☐ Stenographic
- ☐ Typist

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- ☐ Power Plant Engineering
- ☐ Stationary Diesel Engineering
- ☐ Steam Engineering

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- ☐ Personnel—Lab. Rel'n's

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- ☐ TV Technician
- ☐ Practical Radio-TV Engineering

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- ☐ Textile
- ☐ Other (please specify)

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Home Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_  
Occupation \_\_\_\_\_  
Employed by \_\_\_\_\_ Working Hours \_\_\_\_\_

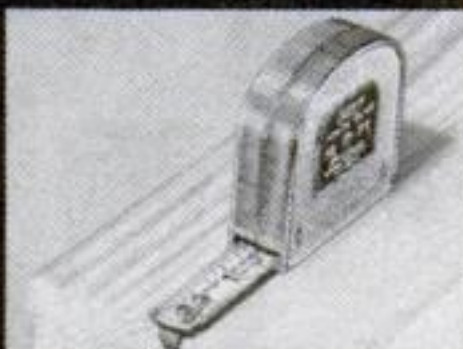
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EASIER THAN EVER TO USE!**

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Slides to compensate for  
hook thickness on both  
hook-over and butt-end  
measuring.



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for convenient carrying.  
Made of strong, light-  
weight plastic.



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is pocket size for quick,  
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10, 12-ft. lengths, ½-in.  
blades, 6-ft. **\$1.19**  
(Also available in ¼-in.  
heavy-duty 12-ft.  
blade.)



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TAPE RULE**  
has press-button blade  
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lengths, ½-in. blades,  
6-ft. **\$1.49**  
(Also available in ¼-in.  
heavy-duty 10-ft.  
and 12-ft. blades.)



Look for Lufkin measuring tools on display wherever  
you buy hardware or building supplies.

Measure for  
measure,  
the finest made

**LUFKIN**  
SAGINAW, MICHIGAN

neat trick to keep a fast boat from squatting.  
But there are other angles to consider.

Forty years ago I had a 16-foot launch with  
a fantail stern and a two-cylinder, two-cycle,  
five-hp. engine. This little round-bottom job  
did eight m.p.h. Figuring 25 hp. would drive  
the boat at least twice as fast, I converted and  
installed a four-cycle Star motor. Result? The  
bow came up, the stern went down, and I went  
nine m.p.h.! My boatbuilder fixed me up by  
installing "squat boards" under the fantail be-  
low the water line. This worked fine and I got  
about 12 m.p.h., but I almost swamped when  
I tried to back up. All of which makes me  
wonder what happens to a transom-stern boat  
with Sea-trim flaps when it tries to reverse; or  
when a big following sea climbs up onto those  
nice broad flats? Maybe they automatically  
hoist out of danger?

ROBERT MATTOON, Mount Carmel, Conn.

. . . In the years 1912-15, when lighter,  
high-speed engines were replacing slow-speed,  
heavy-duty ones, it was common practice to  
equip the fantail of canoe-stern boats with  
"squat boards"—a wooden edition of these  
elevators.

Incidentally, may I say, as a boating man  
with many years' experience, that water safety



and water speed are diametrically opposed and  
the modern tendency toward tiny, fast boats  
venturing into unprotected waters is dangerous  
in the extreme.

H. SUSMAN, Long Branch, N.J.

## Phonograph Almost as Old as PS

I was interested in your listing of old Edison  
phonographs ["I Restored an Antique Phono-  
graph," Oct.]. I have a phonograph I believe  
is older than any of those listed. Made by the  
North American Phonograph Co. of New York,  
it is a cylinder type and wet-battery operated.  
Hard-rubber tubes go in the listener's ears, but  
a three-inch horn can also be used. The motor  
is wound partly on wood and partly on iron.

Patent dates read from Feb. 18, 1878 to May  
8, 1888. A plate on the front says "not for use  
in the State of New Jersey."

It weighs about 100 pounds and I am told it  
cost about \$200.

W. H. MASSEY, Itasca, Tex.

## PS Picture Adds to a Vacation

In September ["PS Readers Talk Back"] Mr.  
H. O. White of Amberg, Wis., told about a  
cylindrical slide rule he used in 1911 at the  
Shenango mine in Chisholm, Minn.

Last summer we spent some vacation time in

CONTINUED



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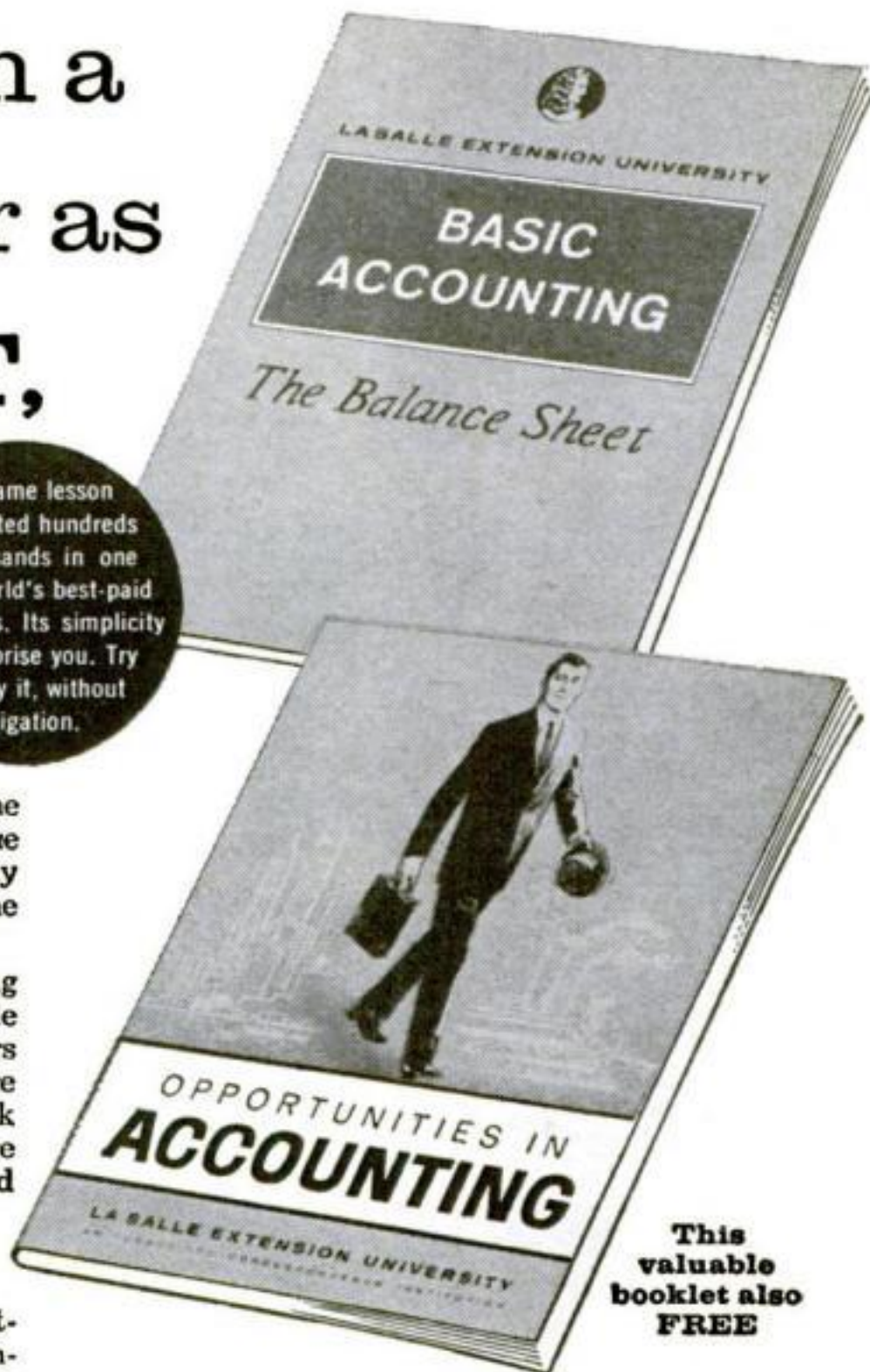
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—Rudolf Urbatis, Port Chester, N.Y.

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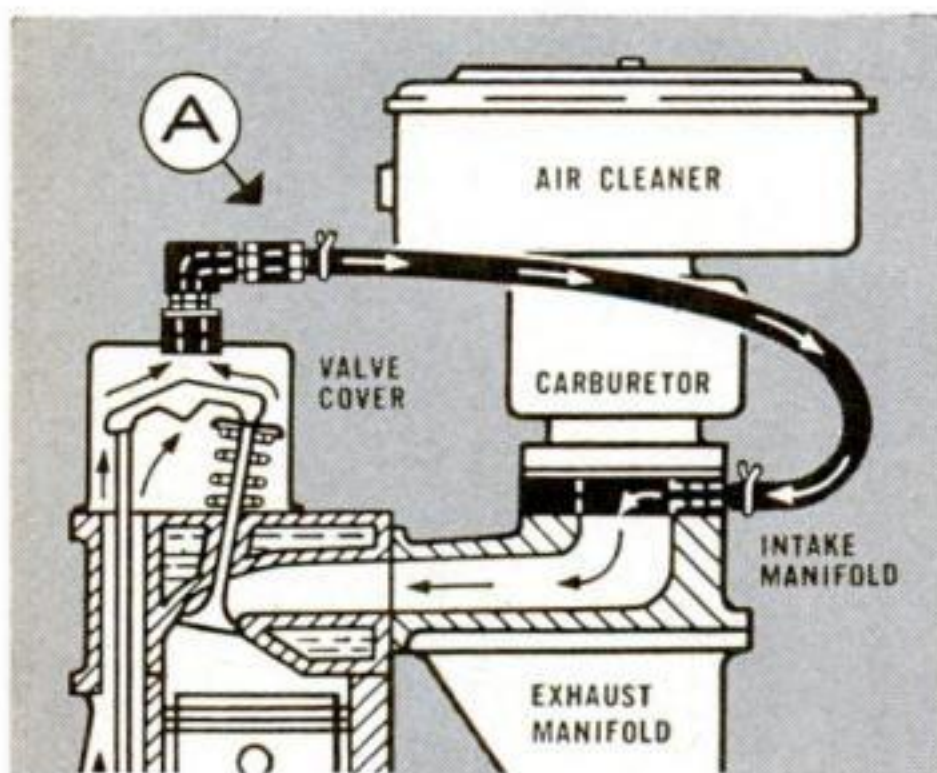
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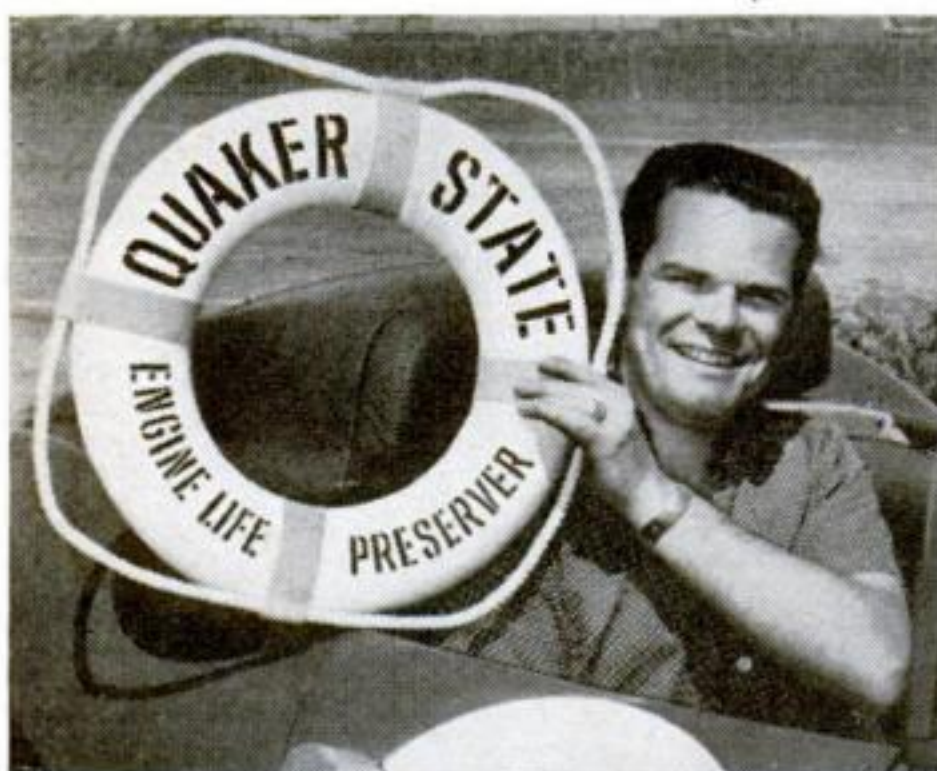
108



## QUICK QUIZ BY QUAKER STATE

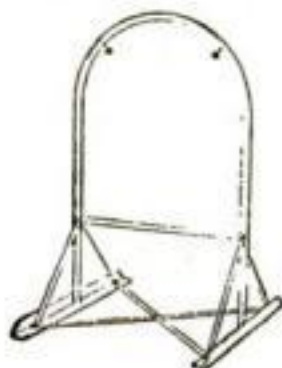


1. What is this device (A)? What is its purpose?



2. What does this symbol stand for?

Pictured at top is an "anti-smog" type crankcase ventilator which prevents crankcase blow-by fumes from escaping to the atmosphere. The life preserver stands for Quaker State Motor Oil—because it is the best engine life preserver. Refined from 100% pure Pennsylvania Grade Crude Oil, it keeps your car on the road, out of the repair shop. Insist on Quaker State—the best engine life preserver.



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Chisholm, visiting the Minnesota Mining Museum. We noted a cylindrical slide rule on display that was evidently the very same one Mr. White used. It was interesting to me as an engineer to see this instrument. I had never seen one until I noticed the picture, captioned "Numbers in the Round" [June, p. 194] that caused Mr. White to write.

EARL BERKHEIMER, Chicago.

### Rx for Auto Thieves

Our town has just suffered the visitation of automobile thieves, and those who still have their cars have come up with these suggestions to thwart them:

- 1) Keep a good watchdog.
- 2) Put a secret cutoff valve on the gas line.
- 3) Fix an electric switch so that if the car is moved it will set off an alarm and flood the area with light.
- 4) Use the same switch to fire a gun loaded with buckshot at the driver's seat.

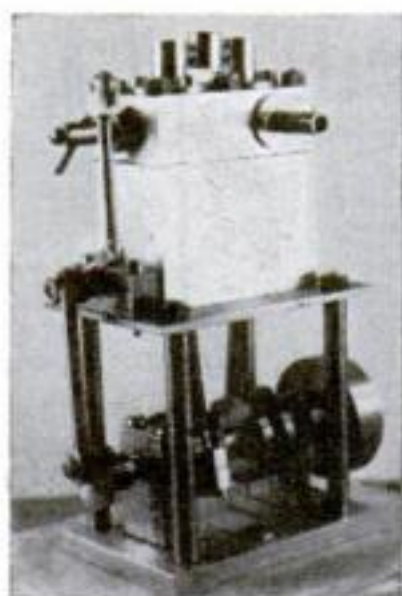
Do your readers have other suggestions?

REV. R. O. FEW, Eatonton, Ga.

### Full Steam Ahead

I thought you might like to see a picture of the engine I built from your plans ["Rotary-Valve Steam Engine," Dec. '61]. It was an intriguing project and I now have it running on steam pressure.

H. C. THATCHER,  
Detroit



### Drivel or Gospel?

This new explanation of "What Makes the Moon Look So Big" [Sept.] is just drivel.

Did you ever look at a sunrise or sunset? The illusion is the same as with the moon, and it's caused by dust particles and water vapor in the atmosphere. In looking at the sun or moon, at its zenith we observe it through the normal thickness of the earth's atmosphere, but in the morning or evening we see it through thousands of miles of atmosphere. This also refracts the light rays from the sun and the moon, causing another illusion: of seeing them before they are at the horizon when rising or still seeing them at the horizon after they have set.

Why did they construct observatories on Mt. Palomar and Mt. Wilson? To get less distortion from the earth's atmosphere. Why do scientists hope to get better views of the planets from space? Again, no atmospheric distortion.

HARVEY NELSON, Detroit.

... The moon story was interesting and the conclusion 100-percent correct. In the terminol-

CONTINUED





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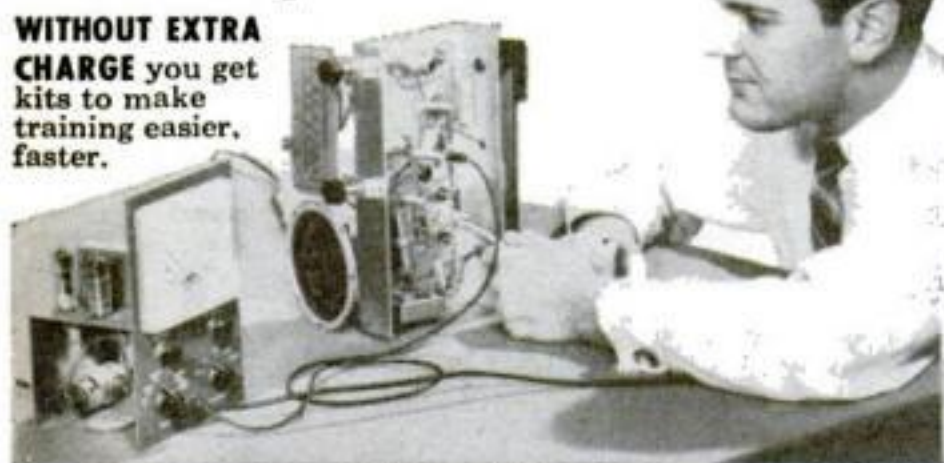
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Newton Centre, Mass.

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ogy of vision, we speak of "figure-ground" relationship. Figure is always larger as it emerges from ground.

To those who do not have time to construct elaborate equipment, the same thing can be proved by using a mailing tube or, if you prefer, two—one for each eye. The tube should be



just large enough so that the moon when viewed almost fills the tube. When you look at the moon near the horizon through the tube, it will immediately appear smaller and farther away just as it does in the zenith.

DR. C. D. MARSDEN, Rocky Ford, Colo.

## PS teach-yourself chase

**STARTS ON PAGE 60**

Your answer was:

**A**

$$m^2 + m = m(m + 1)$$

You are correct, of course.

Very well, we have worked our original problem down from showing that  $n^2 - 1$  is divisible by 8,  $n$  being an odd integer, to showing that  $m(m + 1)$  is divisible by 2, where  $m$  is any integer, either even or odd.

The convenient leverage we have on this problem is that an integer **must** be either even or odd. Now, if  $m$  is an even integer, is the number  $m(m + 1)$  even? That is, is the number  $m(m + 1)$  divisible by 2?

	BOX	PAGE
No	H	57
Yes	U	176
Not necessarily	S	173

Your answer was:

**B**

3.96 is an integer.

No, 3.96 is a decimal fraction. The .96 means  $\frac{96}{100}$ . An integer is a whole number, with no fractional part. 27 is an integer,  $\frac{27}{8}$  is not.

Now return to Box O, Page 170, and try again.



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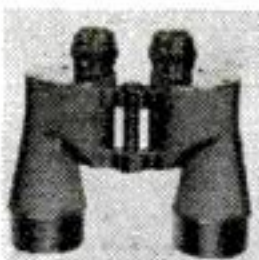
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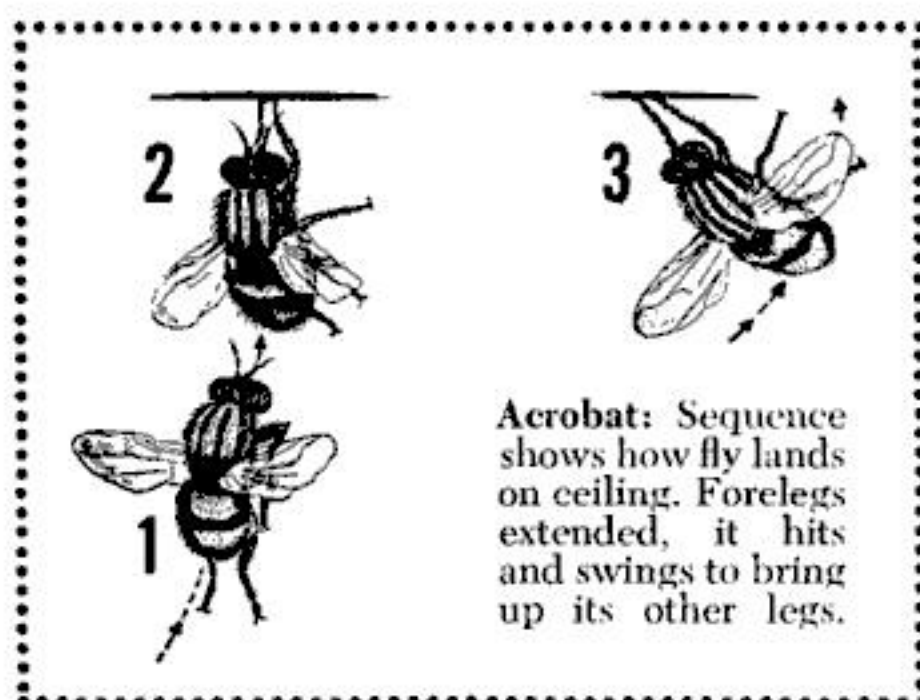
# The march of SCIENCE

By Martin Mann

## How do flies land upside-down on the ceiling?

Entomologists want to know. And these days engineers do, too (space capsules might have to meet for rendezvous or put down on the moon that way). So William G. Hyzer of Janesville, Wis., an expert on high-speed photography, ran a lot of film through his super-slow-motion cameras to find out.

These sketches, adapted from his photographs, show what happens:



**Acrobat:** Sequence shows how fly lands on ceiling. Forelegs extended, it hits and swings to bring up its other legs.

1. The fly zooms straight upward at 10 inches per second.

2. At a body's length away from the ceiling, the fly extends all legs out.

3. When forelegs hit the ceiling, the fly swings its body forward to land the other legs, while fluttering its wings to maintain balance.

It had been thought, up to now, that flies landed on all feet at once. Not so, says the camera.

## The Cocktail-Party Effect goes to work

People write scorching letters to their Congressmen when they learn that scientists are spending government money on research into the Cocktail-Party Effect. It sounds like the most outrageous boondoggle ever invented.

The effect is a remarkable human faculty you have probably noticed: At a noisy party you can easily hear snatches of conversation that happen to interest you, even though they ought to be drowned out by the general din. This, it now seems, may prove very useful to the Army.

At Stanford Research Institute, Menlo Park, Calif., Dr. Maurice Rappaport has been studying the Cocktail-Party Effect (partly with government money). He thinks the Effect depends on the human two-ear, stereo-sound system. He tested his idea by sending several messages at once to people wearing earphones. The message that was meant to get through was sent to both earphones. The other messages—the unwanted ones—were sent only to one or the other earphone. The wanted message came through clearly. Says Dr. Rappaport: "The message heard in both ears seems to be in the center of the head, while sounds heard in only one ear seem to be off to the side." The more messages sent at once, the more the single-ear sounds come

CONTINUED



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**For the reasons why, turn page**

**15**



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# GOOD YEAR

Hi-Miler, Tufsyn—T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



through like background noise—which makes the wanted, two-ear message stand out clearer yet.

This technique could transmit many different messages simultaneously over a few radio channels. If each listener had a pair of channels—one for each earphone—he would hear clearly only the messages that came over both his channels to reach both ears. He would also hear the other messages, but only as a jumble of background noise. With 10 channels, 45 simultaneous messages could be handled this way.

A system like that would simplify Army field radios. It would also be safer against interception by the enemy—an eavesdropper would have to tune in not just one channel but the right pair of channels in order to overhear anything more than garbled noise.

## Wettest days follow the moon

Among the most ridiculous of medieval superstitions is the one about planting seeds at the time of the full moon (sometimes the local shaman specified the time of the new—that is, dark-moon). It turns out that the spook-ridden old peasants may have been onto a good thing after all. Those are good planting dates. For American and Australian scientists now report that cycles of rainfall follow cycles of the moon. And the heaviest rains come three to five days after the full moon and again after the new moon. (The whole idea is so loony that the Australian meteorologists kept their research under wraps until they heard about the similar U.S. studies.)

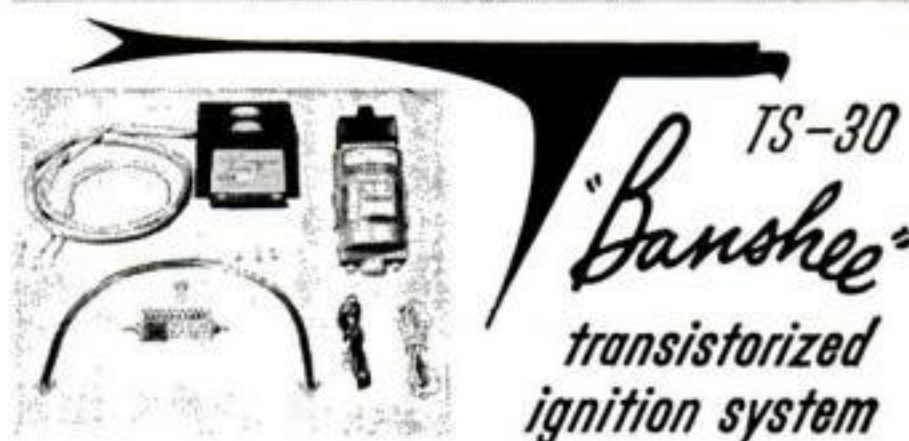
The moon's influence shows up when the "wettest day of the month" is tabulated against the phases of the moon over a great many months. The Americans checked the 16,057 "wettest days" recorded during a half-century (1900-1949) at 1,544 weather stations. Then they checked even farther back in big-city records, which<sup>2</sup> cover nearly 100

years. The Australians plotted 25 years' reports from 50 stations. All the curves match. Heavy rain falls three times more often the week after a full moon (and new moon) than the week before.

How come? The Australians suspect meteor dust, which falls into the atmosphere and could "seed" rainfall. The amount reaching the atmosphere might change as the orbiting moon—through its gravitational attraction—"swept" the dust clouds closer to or farther from earth. This effect alone, however, isn't enough to account for the rainfall pattern, which leaves the meteorologists no better off than the medieval peasants.

CONTINUED

## NEW FOR '63!



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*These great minds were Rosicrucians . . .*



Francis Bacon Benjamin Franklin Isaac Newton

**WHAT SECRET POWER DID THEY POSSESS?**

The March of Science . . . continued

## Secret of eternal youth?

The search for the Fountain of Youth continues. At the University of Pittsburgh, Drs. T. S. Danowski and Campbell Moses set out to learn if body changes that come with age—such as the increase of cholesterol in the blood—were really inevitable or simply symptoms of hormone deficiency. So they dosed 84 volunteers with hormones. Sure enough, cholesterol in the middle-aged man dropped to youthful levels.

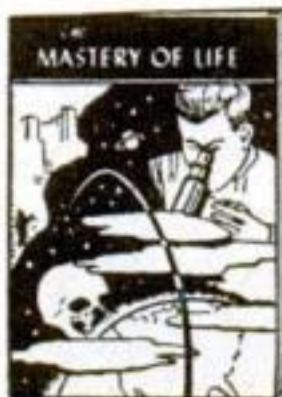
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## PS teach-yourself chase

**STARTS ON PAGE 60**

Your answer was:

**C**

$$m^2 + m = m(m + 0)$$

In factoring an  $m$  out of each term in the expression  $m^2 + m$ , you're dividing each term by  $m$ . When you divide  $m$  by itself, you don't get 0 for a quotient, do you? You get 1.

Any factorization can always be checked by multiplying the factors together again to see if you come out where you started. If you multiply  $m + 0$  by  $m$ , you don't get  $m^2 + m$ , do you?

Now return to Box X, Page 180, and choose a better answer.

Your answer was:

**D**

37 is an integer.

You are correct. 37 is a whole number. The other choices offered were fractions, and therefore not integers.

Very well, the theorem we wish to prove is that if  $n$  is an odd integer, the number  $(n^2 - 1)$  is divisible by 8. For example, if  $n = 3$ ,  $(n^2 - 1) = (3 \times 3) - 1 = 9 - 1 = 8$ , which is obviously divisible by 8. If  $n = 7$ ,  $(n^2 - 1) = (7 \times 7) - 1 = 49 - 1 = 48$ , which is, again, obviously divisible by 8.

Does our theorem say that  $(n^2 - 1)$  is divisible by 8 if  $n = 6$ ?

Yes

No

**BOX PAGE**

Q 173

N 166



**Learn Electronics! Build Exciting Projects With Satellite Solar Cells!\***



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# Getting Ahead

A monthly column on how to prepare yourself for a better job



Dr. Lewis R. Fibel

This month POPULAR SCIENCE begins a feature column designed to answer your questions on jobs and technical schools: Where do you go to study missile guidance systems? Who makes more money — an electronics technician who tests out hi-fi pickups or a mechanic who works on spacecraft escape hatches? Is there some place near you where you can study commercial photography at night?

Lewis R. Fibel, Dean of Michigan's speedily growing Flint Community Junior College, has the special job - plus - academic - background to supply the answers to such questions. His studies in chemistry led to degrees from schools as widespread as Cornell, the University of Kansas, and the Polytechnic Institute of Brooklyn. A stint in the Navy in World War II and 14 years as a research chemist in industry lay behind him before he came to the New York City Community College. There he headed the Department of Chemical Technology and later became Dean of Students. He moved to Flint this fall.

*"I'd like to study auto mechanics, but I don't know where I can get the training in my area. What would you recommend?"—A.O., Dutton, Mont.*

Auto mechanics is regularly offered in vocational high schools. You can check with the local superintendent of schools or your state department of education to find out if there's a school near you.

Some junior colleges also offer courses in auto mechanics. Here are three in your area, all in Idaho.

Boise Junior College (Boise).

North Idaho Junior College (Coeur d'Alene).

Ricks College (Rexburg).

Write directly to the registrar of each institution for further information. The first two schools listed charge a yearly tuition (about \$300) to nonresidents of Idaho. The third is a private institution with a tuition of about \$750 a year.

Correspondence courses in auto mechanics are available from such schools as:

International Correspondence Schools, Scranton 15, Pa.

National Technical Schools, Los Angeles 37, Calif.

*"Can you suggest a good source of information for careers in commercial art?"—R.H., Paducah, Ky.*

Donald Holden's *Art Career Guide* (Watson-Guptill, 1961) is one of the latest and best books on the subject I've seen. Holden discusses cartooning, illustrating, design, and other careers. Try your public library for a copy.

*"I have read that math is important if you want to become an electronics technician, I just got out of the Navy after four years and I guess I'm pretty rusty. What would you suggest?"—B.G., Mansfield, Ohio.*

The demand for technicians in electronics is growing impressively. Government reports indicate that there is a need for at least two technicians for every engineer. With the growing shortage of engineers there will be an expanded need for skilled technicians — persons qualified to take over more of the engineer's job.

However, before deciding to enter the field, ask yourself what satisfactions you can derive from it, including money: Beginning technicians earn from \$75



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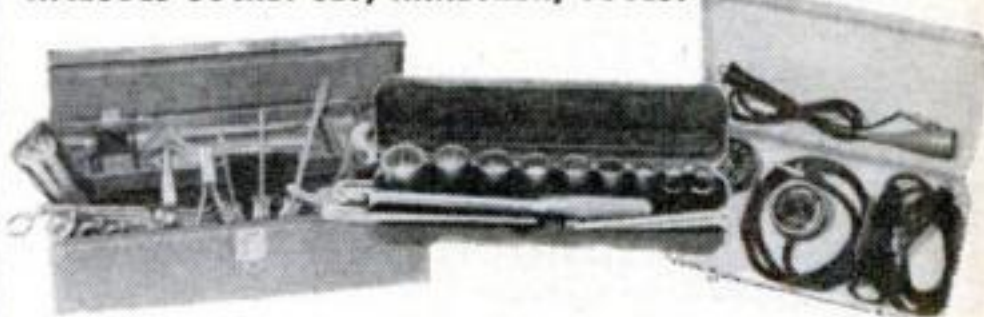
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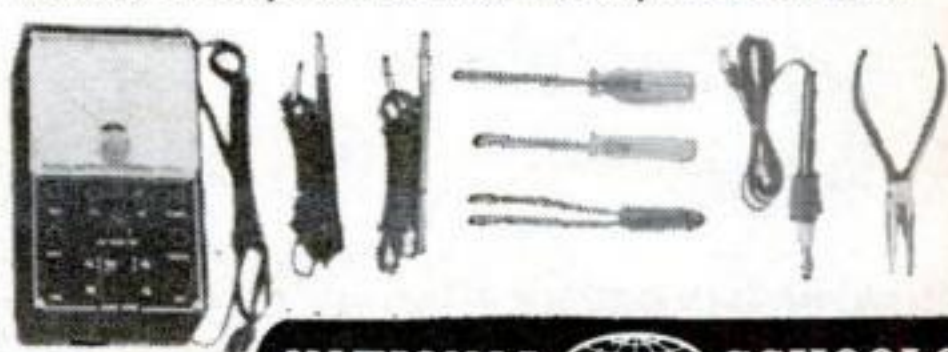
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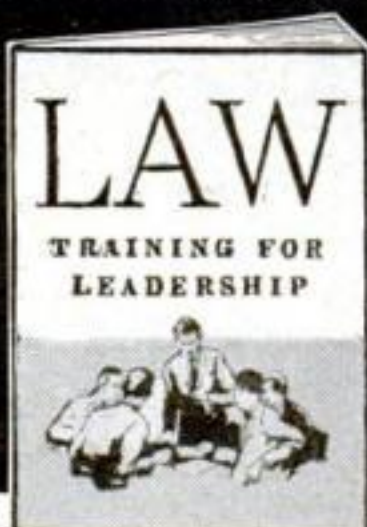
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to \$95 a week. Advancement is well-nigh certain. I would also suggest you talk to someone in the field and put yourself in his shoes. Find out if he works a regular shift; if there is a lot of overtime; if he has to wear a uniform.

As for mathematics, you're right in assuming that it's important. You should have high-school math through intermediate algebra at least—and really know it. In your case I'd suggest you take a review course in algebra, perhaps by correspondence, before beginning formal training.

*"I'm 15 years old and just entering high school. I want to be an astronomer. What subjects should I take?"*  
—J.L., Tacoma, Wash.

First, you need a good general academic program with as much mathematics, science, and foreign language as you can get—at least three years of French or German. (Continue the language in college.) You will want to do well in *all* your academic subjects. You should, of course, work closely with your counselor, who will be able to advise you more specifically as he observes your progress.

Second, I would urge that your extracurricular reading include a lot about astronomy and astronomers.

Third, remember that if you're not happy with the abstract level of astronomy there are a number of trade and technical vocations associated with the field. There is always a demand for persons skilled in navigating (one practical application). There is also a great need for persons qualified to make or repair the complex optical and radio instruments that modern astronomers use. You might also want to consider a career that involves the statistical calculations and analysis of the data such instruments produce.

.....

Send your questions on careers and technical training to:

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355 Lexington Ave., New York 17, N.Y.  
Not every question can be used. Questions cannot be answered by individual letters.





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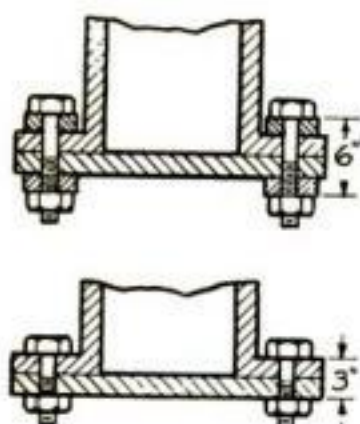


# SHOP TALK

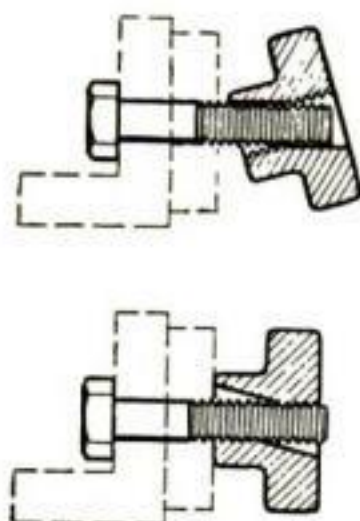
By Sheldon M. Gallagher



## Surprise—long bolts hold better than short ones



Believe it or not, you get more clamping force from a long bolt than a short one, say experts at the Russell, Burdsall and Ward Bolt and Nut Co. of Port Chester, N. Y. The reason: In order to apply force, all bolts stretch about .001" for each inch and each 30,000 p.s.i. of tension. If the bolts at left are all tightened to 60,000 p.s.i., the short ones will stretch .006" and the long ones .012". Burrs and scale under the heads and nuts eventually flatten—say .002"—and cause the bolts to loosen. This .002" slack is one-third of the short bolts' .006" stretch, but only *one-sixth* of the long bolts' .012" stretch. So the short bolts lose 30 percent of their clamping force, while the long ones lose less than 17 percent. The difference doesn't matter on small jobs, but can be important where there are heavy loads and vibration.



## Tip of the month: Quick-acting knobs for clamps

Our recent nut-and-bolt puzzle prompts H. P. Hilaman, a Bloomington, Ill., tool designer, to suggest that PS readers might find it useful to know about quick-acting knobs that slide over bolt threads. The knobs have a diagonal opening with staggered threads, as shown at left. By tilting the knob you disengage its threads and it slips free. At the desired point, the knob is turned straight to engage the threads for tightening. A fine notion, it seems to us, for making fast-acting clamps and jigs. Northwestern Tools, 117 Hollier Ave., Dayton, Ohio, makes the knobs.



## Those old-time hog rings—now they're for people

A long-time maker of hog rings for industrial uses has decided to let the public in on them, too. The rings, originally made for hogs years ago, are those U-shaped, staple-like fasteners you see on some furniture upholstery. Now, for 98 cents, you can buy a supply of the rings plus a special tool that squeezes the rings closed, as shown at left. The rings are handy for jobs like joining wire fencing, installing auto seat covers, and stapling vines to trellises. They're sold by Republic Fastener Products, 216 Midland Ave., Saddle Brook, N. J.

## Smart idea: Tools that come with instructions

The Easi-Bild pattern people have come up with a slick plan for promoting the use of masonry tools around the home. They sell you a complete kit of masonry tools together with an instruction booklet that shows you how to use them. The 36-page



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**STARTS ON PAGE 60**

Your answer was:

I don't know how to square

$(2m + 1)$ .

To square an algebraic expression having two terms, proceed as follows: Multiply the first term by itself; multiply the second term by twice the first term; multiply the last term by itself, and add the products. For example,

$$(a + b)^2 = a^2 + 2ab + b^2$$

In the example above, the first term,  $a$ , is multiplied by itself to give  $a^2$ ; the second term,  $b$ , is multiplied by twice the first term to give  $2ab$ ; and the last term is multiplied by itself to give  $b^2$ .

What is the square of  $(3x + 2)$ ?

	BOX	PAGE
$(3x + 2)^2 = 3x^2 + 12x + 4$	J	63
$(3x + 2)^2 = 9x^2 + 12x + 4$	R	173
$(3x + 2)^2 = 9x^2 + 6x + 4$	Y	180
How do you multiply $3x$ by itself?	W	179

Your answer was:  $\frac{1}{3}$  is an integer.

You have it backwards. Integers are whole numbers with no fractional part. For example, 27 is an integer;  $\frac{27}{8}$  is not.

Now return to Box O, Page 170, and try again.



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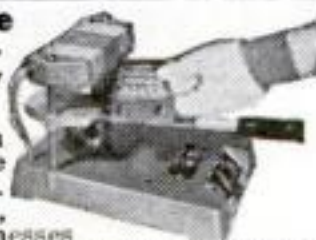
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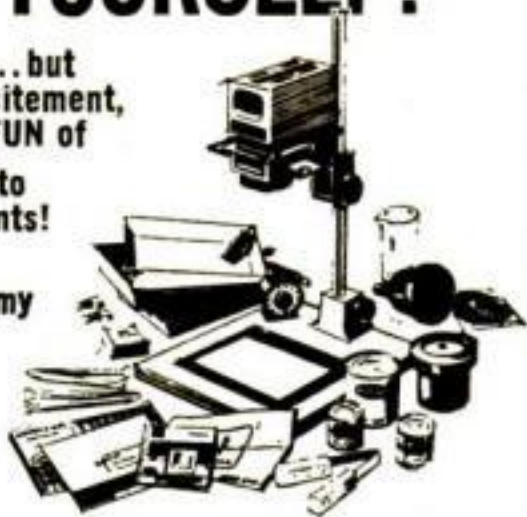
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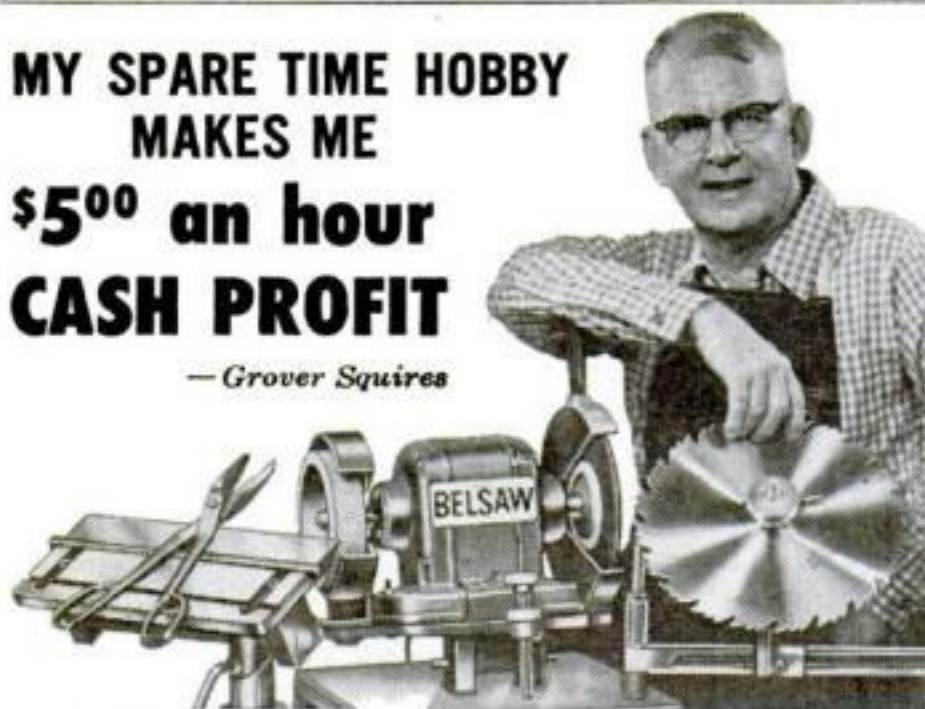
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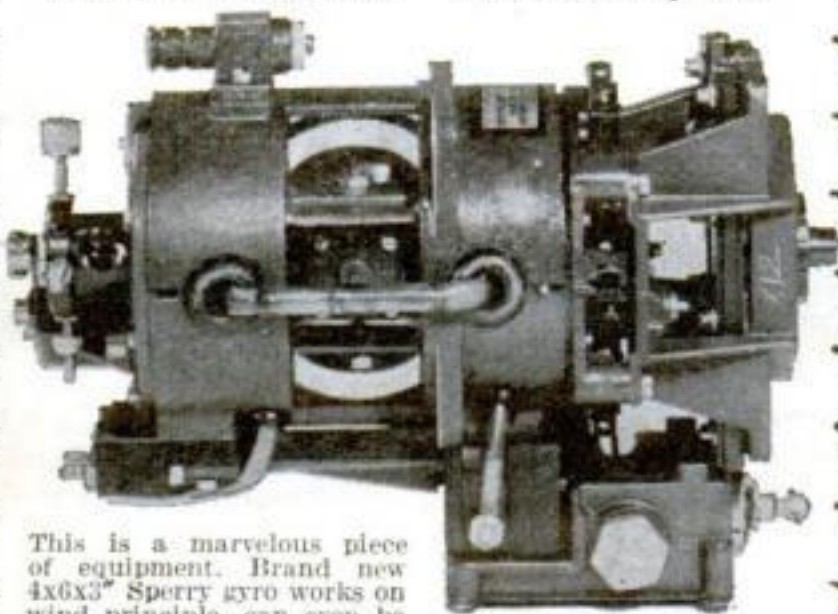
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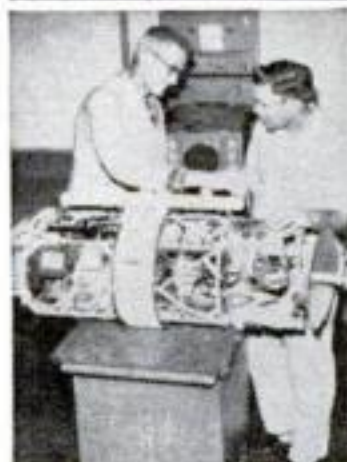
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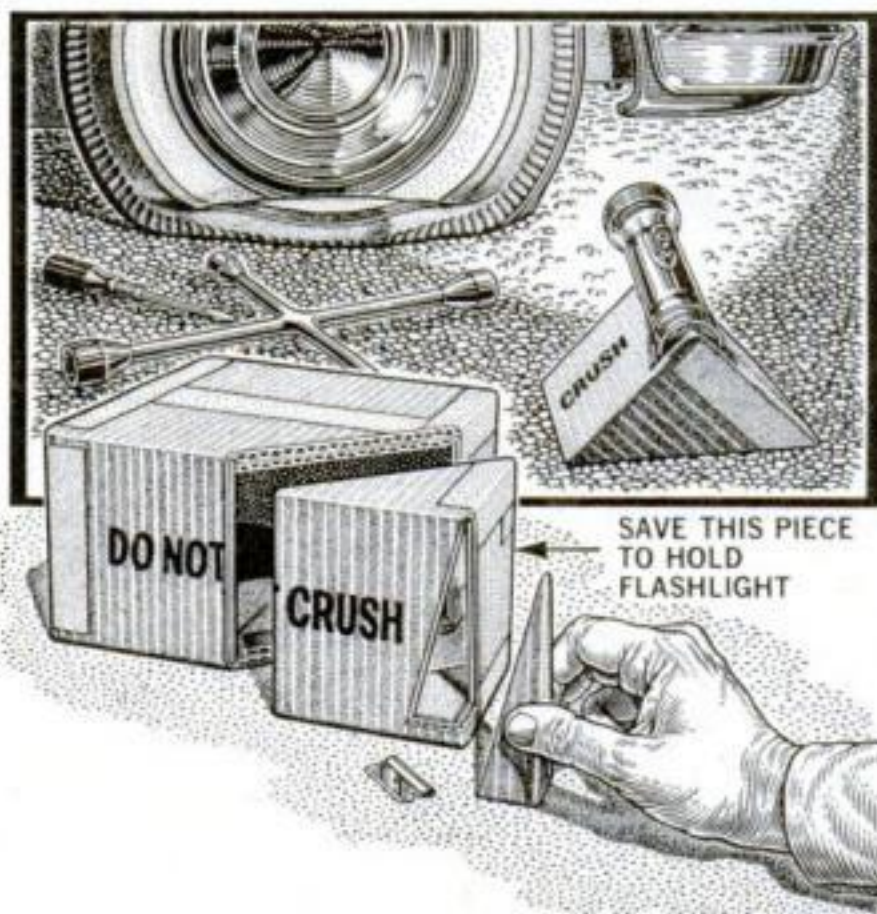


# Hints from the Model Garage

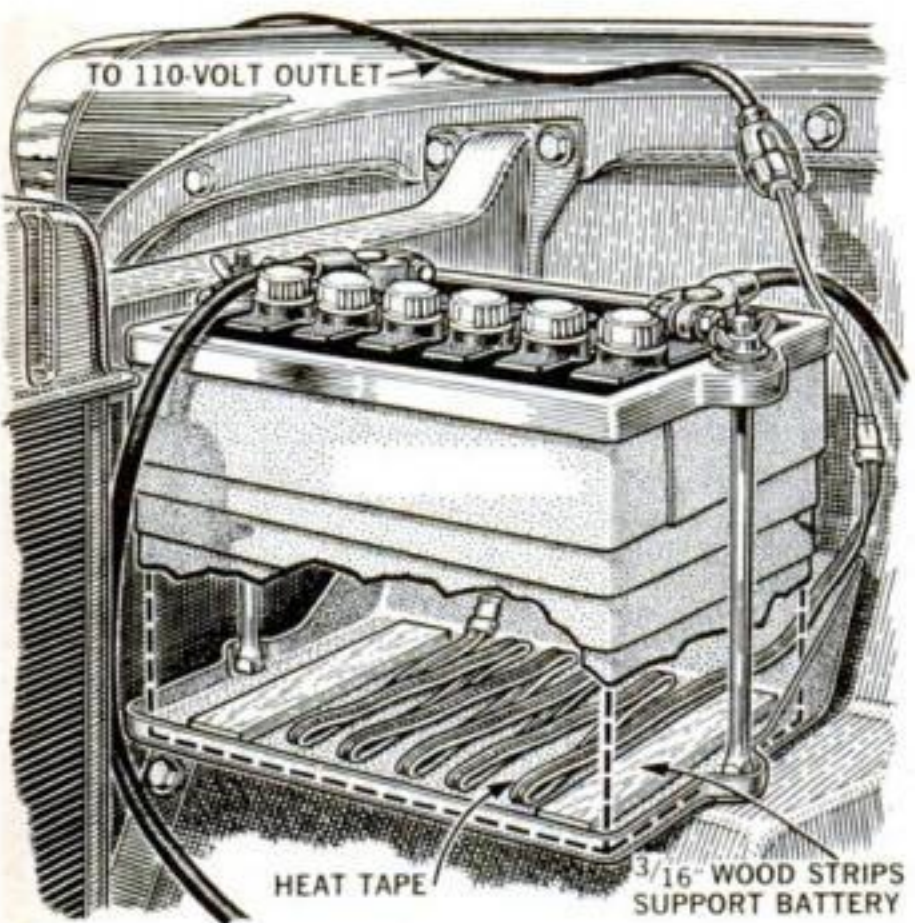


HOLD FINGER OVER AIR HOLE OF GARDEN SPRAYER

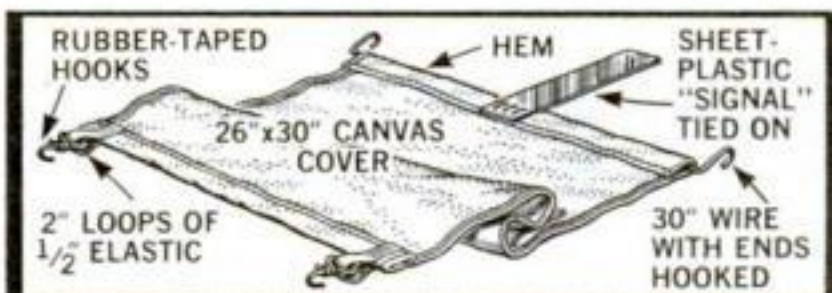
Car washing is easier if you spray on the soap. Pour a spoonful of car shampoo into a garden sprayer, fill the sprayer with water, and attach a hose. Turn on the water tap and hold your finger over the air hole to cover your car with rich suds.



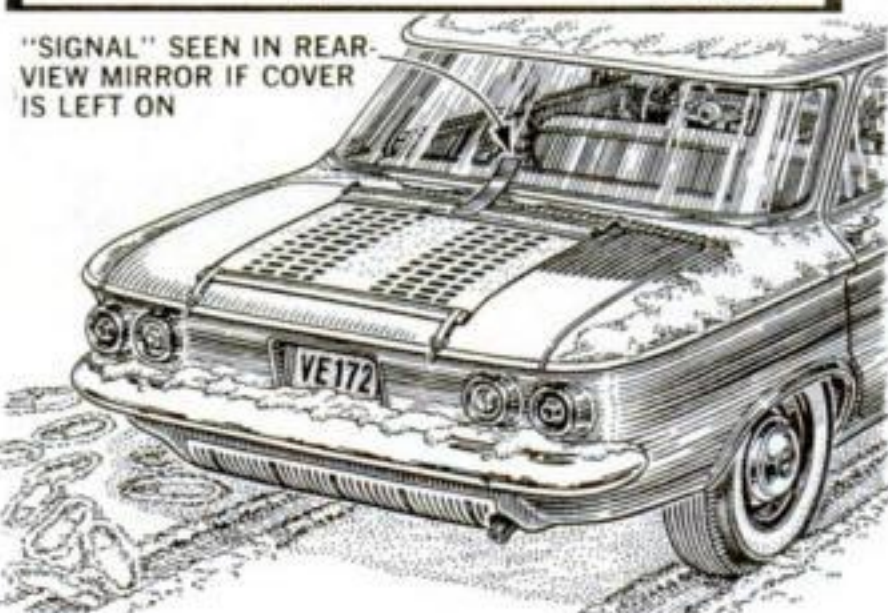
This makeshift flashlight holder points the beam where you want it for emergency repairs on a dark road. With a razor, cut a corner off a sturdy carton. Then carve out a wedge-shaped notch large enough to hold the flashlight securely.



A cold battery is weaker. To warm it for faster morning starts, put a 110-volt, six-foot heating tape (the kind used to warm outdoor water pipes) under the battery and plug it into house current. Wrap the battery in fiber-glass to retain heat.

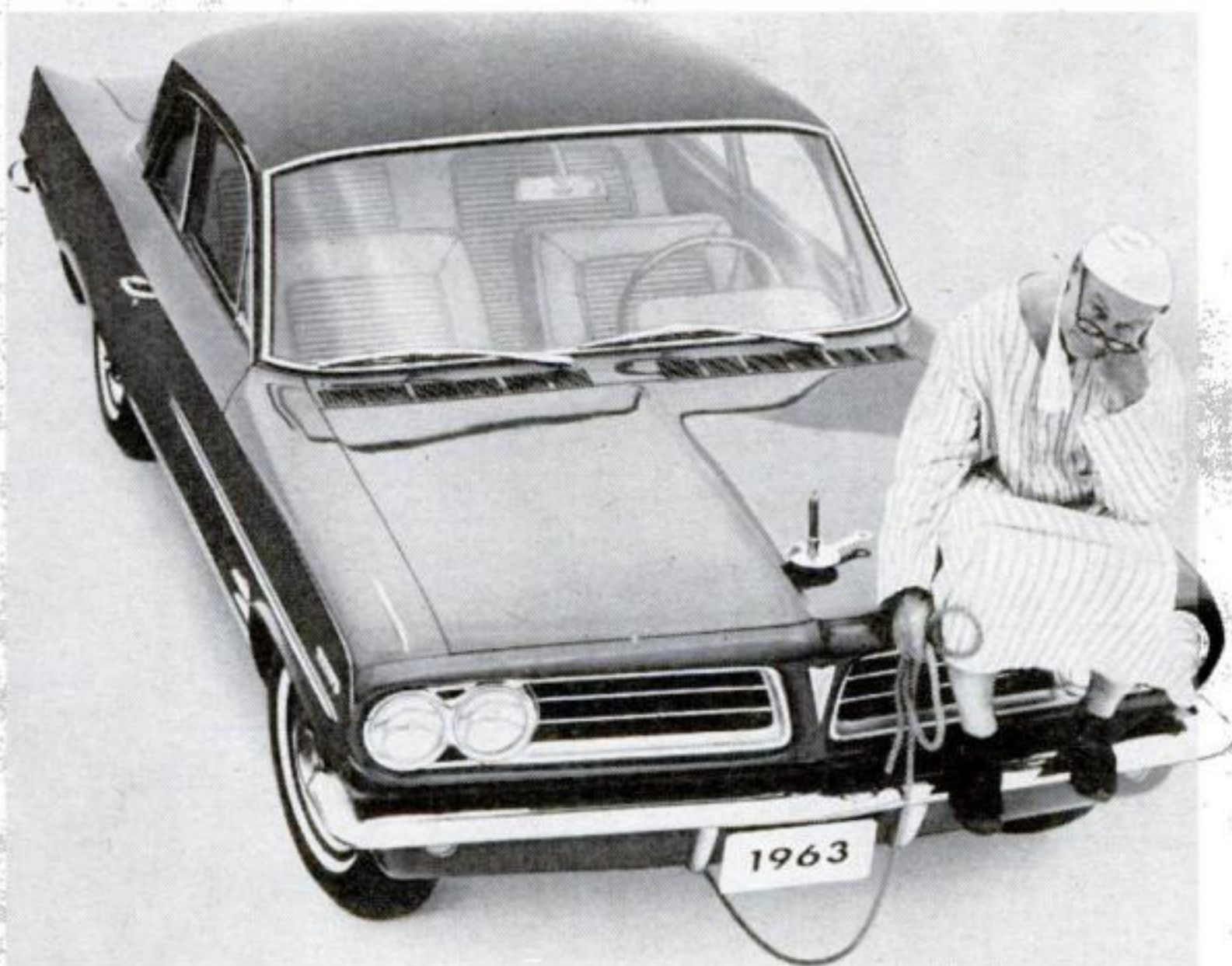


"SIGNAL" SEEN IN REAR-VIEW MIRROR IF COVER IS LEFT ON



A Corvair hood cover made of canvas, coat-hanger wire, and elastic keeps the louvers from freezing over when the car is parked outside during a snowstorm. Clogged louvers keep fresh air from cooling the engine, often resulting in overheating.





Pontiac Motor Division • General Motors Corporation

\*optional at extra cost \*\*up to 166 bhp at extra cost

## **I'm sure it's a lovely car, Destry, but in the bedroom . . . ?**

*Some cars have personality. They're the kind you hate to leave out in the rain (and not just because you're too lazy to start polishing all over again). The kind that bring back a long-disremembered sensation: That excitement you felt when you bought your first car. The new Le Mans is like that.*

*It isn't just the way it looks; there are other cars almost as good-looking as the '63 Tempest Le Mans. It isn't just the bucket-type seats or the floor shift or the extra-cost-option tachometer; other cars have pretty reasonable versions of this pizzazz.*

*It's when the thing is turned on and set in motion that the new Le Mans starts to worm its way into your affections,*

*develops that personality we were speaking about.*

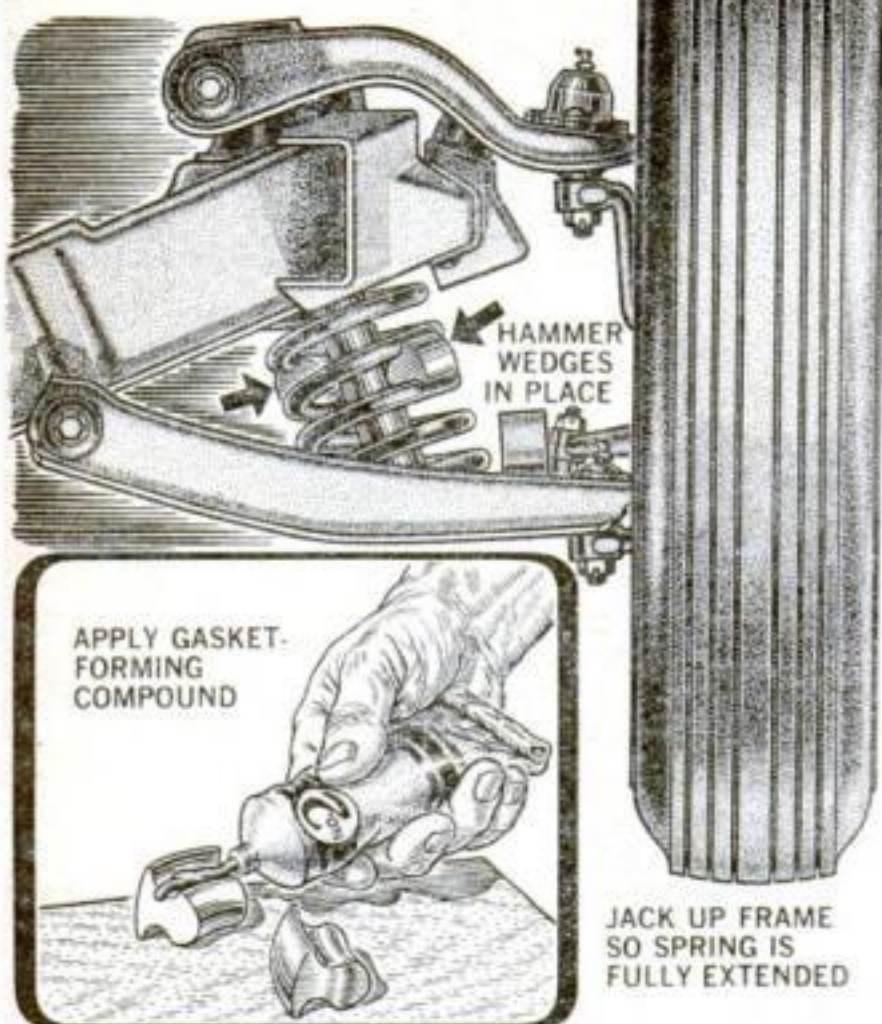
*Some of it comes from the way our new 326 cu. in. V-8\* rouses its 260 bhp and makes tracks (our 115 hp 4\*\* with gentle thirst and the manners of an 8 is still standard equipment). Still more of it comes from the way the new rear suspension handles the handling. You point it, it goes that way, and no shilly-shallying.*

*The quieter, more positive shifting automatic\*, the self-adjusting brakes, the 20-gallon gas tank (up from 17), the beefier differential unit, they're all nice. But it's the personality we like best about our new Le Mans.*

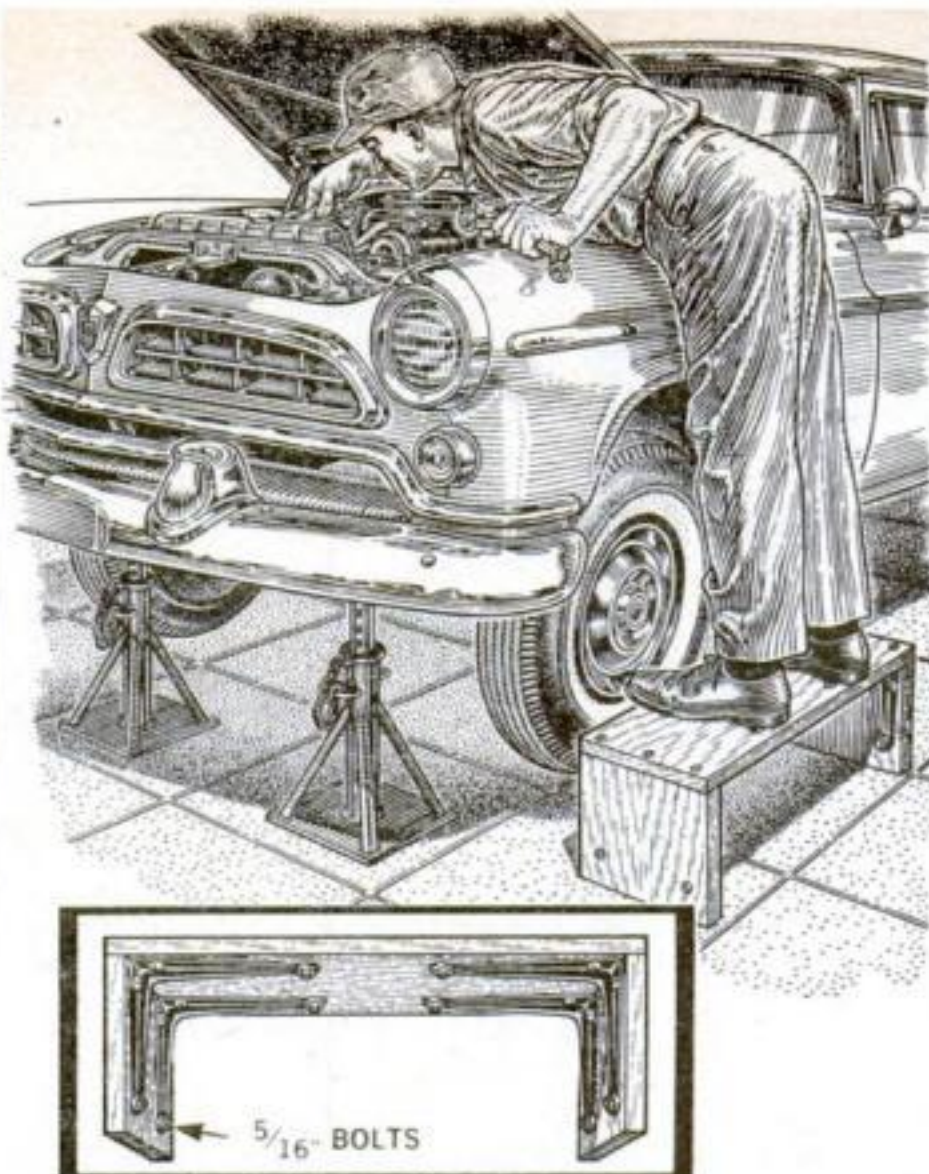
**Pontiac Tempest**



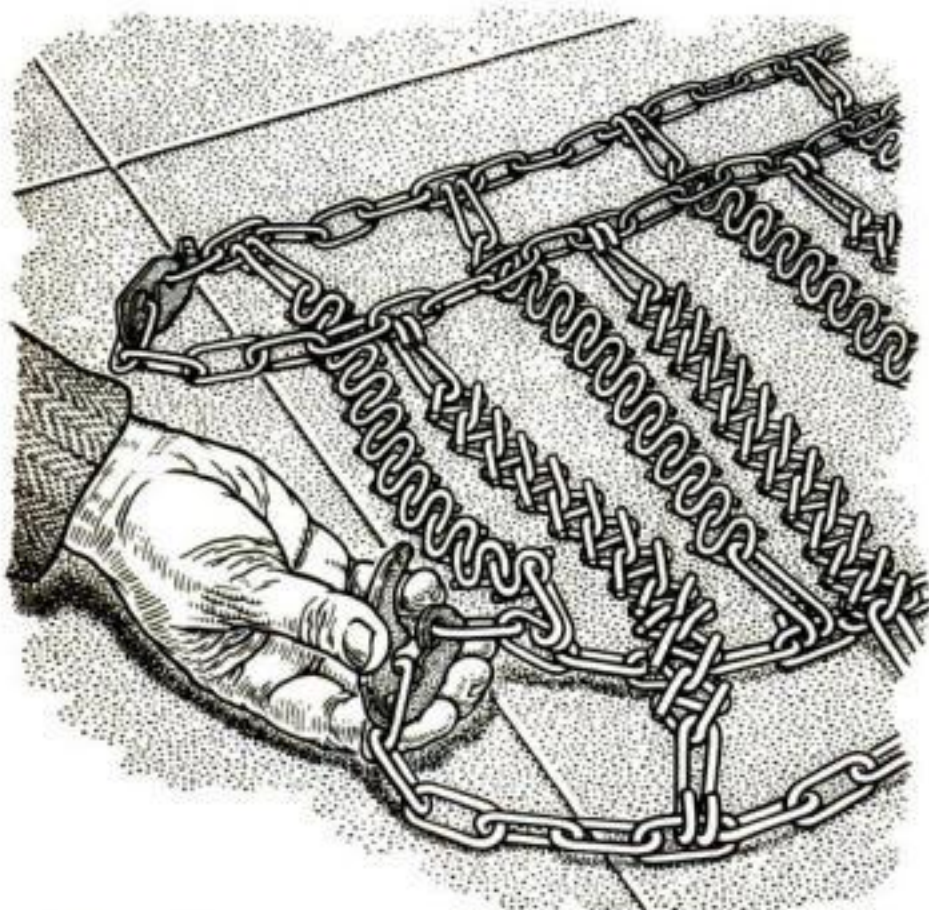
## More Hints from the Model Garage



Sagging coil springs can be cured by inserting accessory spacers between the coils. But on rough roads, when the springs distend, the spacers often fall out and are lost. Apply pliable gasket-forming compound to keep them in place.



Reaching into an engine compartment is tough when the car is jacked up. This stool comes to the rescue. It's made of 1"-thick plywood. The 10"-by-10" ends are fastened under the edges of the 30"-by-10" top by four 6"-by-8" steel shelf brackets.



Snow chains won't get tangled if you take this simple precaution: After using the chains, lay them out flat and fasten the ends together before storing. Next time you need them, you won't have to stand in the cold and unsnarl them.



Frozen door locks are no problem for a pipe smoker. Just stoke up the old briar and, with the bowl opening at the lock, blow through the stem. The hot blast of smoke directed at the lock will thaw out the mechanism within seconds.



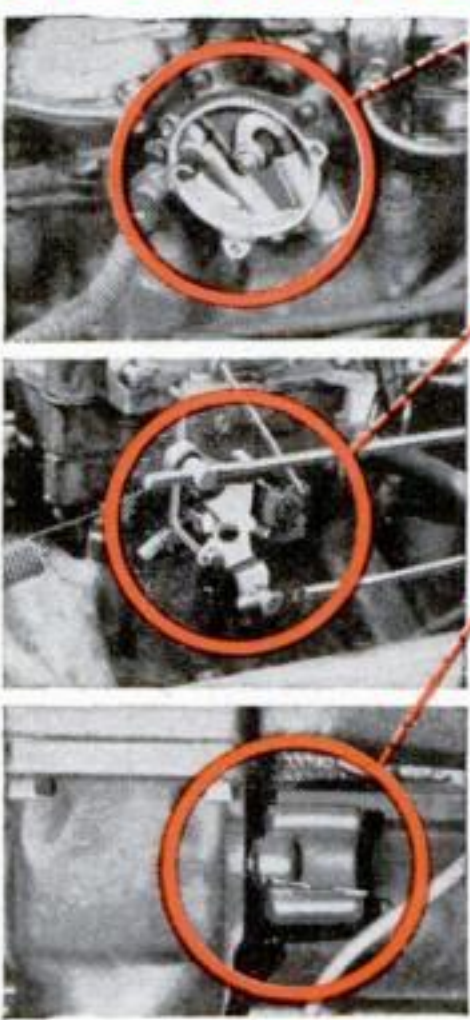
Fix sticking automatic chokes fast . . .

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# Detroit report

By Devon Francis

## Long-term warranties

Chrysler Corp. really started something with its five-year or 50,000-mile warranty. Ford Motor Co. and Studebaker have extended their warranties—starting with their entire 1963 lines—to two years or 24,000 miles, whichever comes first. But unlike Chrysler's five-year plan, which covers only the engine and drive train, the Ford and Studebaker warranties include all parts and labor except normal maintenance operations and routine replacement items. Chrysler still offers, in addition to its five-year or 50,000-mile warranty, a one-year or 12,000-mile general warranty.

## Four on the floor

Chrysler Corp. has finally given in to the demands of performance enthusiasts and adopted the Borg-Warner four-speed manual floor shift as an option. It's basically the same smooth gearbox used by General Motors, Ford, and Studebaker. It'll be available with Dodge and Plymouth V-8s, but not in station wagons. Nor can you get it with the 426-inch high-performance engine—too much torque for the box, say Chrysler engineers.

## Lively ones from Ford

A new Ford super-engine is rumored to be on the way. It will displace about 427 cu. in.—just nosing in under the 427.2-cu.-in. NASCAR and National Hot Rod Association limit—and will be a part of a high-performance package that includes heavy-duty suspension, brakes, and driveshaft. Ford will continue to produce the 406, too.

Look for a still larger engine for the Fairlane. It started out as a 221-incher, then was hogged out to 260 inches. Latest word is that still more inches will be squeezed out.

Ever wonder how a Falcon would perform with a Fairlane V-8 under its bon-

net? You may soon get a chance to find out. Ford's "1963½" Falcon, due in the spring, should offer this V-8 as an option.

## Chrysler schedules turbines

The auto industry is feeling the hot breath of the gas turbine on its collective neck. Next April, at the International Auto Show in New York, Chrysler will introduce its turbine-powered Typhoon, complete with sporty body designed by Ghia of Italy. But the 50 or 75 that are to be sold won't be available until next fall.

Chrysler is also expected to produce a much larger number of cars with the same Ghia body but with conventional engines.

How will the major components of the turbine engine be made? Speculation up to now has been that some sort of casting process would be used. Not so. The engines probably will be made of welded sheet metal, indicating that low-volume production is planned.

## Studebaker's 1964 Line

Larks and Hawks will have "advanced" styling and several surprising engineering changes, sources at Studebaker report. The styling is a blend of ideas by Raymond Loewy, who designed the Avanti, and Brooks Stevens, who is responsible for the face lift on the 1963 models.

## Are turbochargers impractical?

Buick and Pontiac have done a good deal of development work on turbochargers, but both decided against using the blowers in 1963.

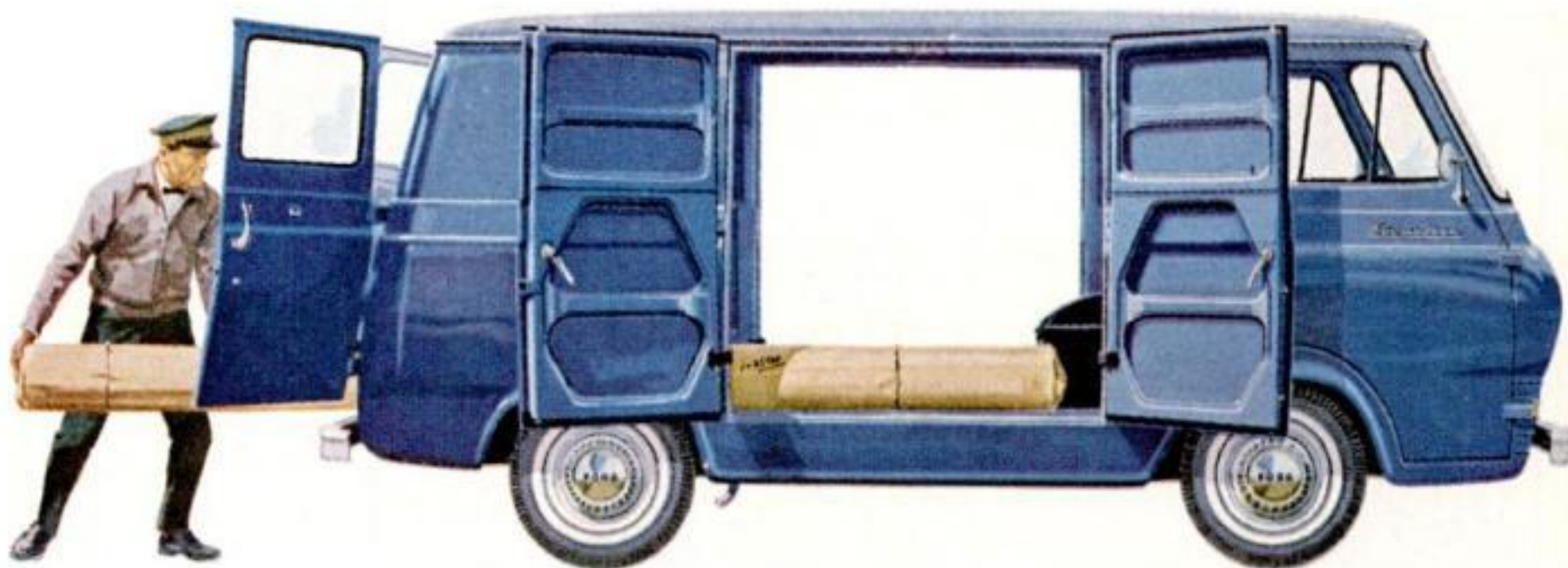
As late as last summer, Buick had planned to equip the Riviera with a turbocharger. But at the last minute it was decided that the added performance wasn't worth the complications and extra cost involved. Pontiac, the most performance-minded division of GM, got all the performance it needs in the Tempest by dropping in a 326-cu.-in. V-8. This is the regular Pontiac V-8 with smaller bore.



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First to fly within  
exploring range  
of another planet,  
our keen-eyed  
Mariner 2  
spacecraft is—

# Keeping a Date with Venus

Dramatic climax of Mariner's voyage takes craft across face of Venus, from dark to sunny side.

By Wesley S. Griswold

**T**HE world will get its first close-up look at another planet—if luck holds out—on December 14 between 10 and 11 a.m. Pacific time.

At that likely-to-be-historic moment, the gold, silver, and blue U.S. spacecraft Mariner 2 has a date with Venus. It will fly past Earth's sister planet at such close range, less than 21,000 miles, that Venus will loom up before it as big

as a basketball at arm's length. Instruments aboard it will scan Venus' cloud-wrapped face.

And if no mishap has stilled the craft's radio, Mariner will send us the most exciting news in the annals of exploration. It's expected to tell us at last what mysterious Venus' surface and atmosphere are like, and answer the most fascinating question of all: Can there possibly be life on Venus?

Four other attempts to explore Venus,

CONTINUED

43



one American and three Russian, have failed. A Russian try last year got a spacecraft within 62,500 miles of Venus, but to no avail—its radio had gone dead long before. Remembering that misfortune, Mariner 2's sponsors were sweating out the suspense of its 109-day voyage as this issue went to press—but thus far, since its August 27 launching, all was going incredibly well.

The \$10,000,000, 447-pound craft on its way to Venus, built and operated for NASA by Caltech's Jet Propulsion Laboratory, looks like a flying weather vane. It measures 16½ feet the longest way—the span of its blue-tinted solar panels.

Positioned by tiny attitude-controlling nitrogen jets, Mariner keeps these panels always facing the sun. They turn sunlight into electricity—up to 222 watts—to power a radio transmitter so small you could hold it in your hand, a 41-pound payload of instruments, and Mariner's computer brain. Hinged and kept trained on Earth, a long-range antenna sends back the instruments' reports. With almost-human talents, the electronic brain directs all operations, following preflight instructions and in-flight radio commands.

If an observer could watch the climax of Mariner's 180,000,000-mile journey to Venus, he would see a breath-taking drama enacted. Gradually overhauling Venus, Mariner will swing in toward it on a near-collision course—like one express train racing another to an oblique crossover. Barely before Mariner reaches the crossing, the awesome bulk of Venus will whiz across its path at more than 78,000 m.p.h. Flashing over the crossing in hot pursuit, the even faster-moving spacecraft will catch up with Venus—and pass alongside the planet, on its inward and sunlit side.

**Making "eyes" at Venus.** During the spectacular encounter, an eyelike instrument—a little dish antenna, 20 inches

across and three inches deep, called a microwave radiometer—will ogle Venus. Pivoted to be rocked up and down, it will scan the planet's disk in a zigzag fashion, progressing from the dark side to the sunny side. Mounted on the edge of the dish, so that it will always be looking at the same portion of the planet, is a second "eye" called an infrared radiometer.

Both will pick up Venus and start their scanning at a range of 24,516 miles, hardly more than the planet's circumference. They'll end observation just 41 minutes and 40 seconds later, on the sunny side of Venus and only 21,291 miles away. (The dish's right-angle mounting, and Mariner's heading, cause them to lose sight of Venus a trifle before the closest, 20,918-mile, approach.)

Since clouds hide the planet's surface, looking at Venus with a camera would reveal little. Radiometers provide subtler ways to pierce the cloudy mask. The microwave instrument picks up the planet's natural or "thermal" radio emission—resulting from its own heat—at two selected wave lengths of 13½ and 19 millimeters. The infrared instrument detects heat radiation at the shorter wave lengths of 8-9 and 10-10.8 microns.

By ingeniously piecing together the surprising variety of clues obtainable at these particular wave lengths, scientists hope to settle wildly contrasting speculations about Venus' surface: Is it a steaming swamp, an unbroken ocean, or a dusty and searing-hot desert?

**Taking her temperature.** Measuring the intensity of Venus' radio emission will tell the temperature of the planet—the main task assigned to the microwave instrument. That will check out an astonishing 600 degrees for Venus' surface, measured from earth by the same new technique—if correct, a shattering blow to any hope of finding life on Venus, and even of landing there in

CONTINUED

Venus-observing instruments of Mariner 2, together with other instruments and principal flying gear, are shown in view opposite—on a model of the spacecraft. Bowl resembling search-

light, near center, is pivoted dish antenna that rocks back and forth to scan Venus with radiometers that take the planet's temperature and tell what's in its atmosphere.



Short-range transmitting antenna

## For Venus Observations:

### MICROWAVE RADIOMETER

Takes temperature of surface of Venus; looks for water vapor in atmosphere

Horn antennas point at empty space for comparative microwave readings

### INFRARED RADIOMETER

Measures atmosphere's temperature and carbon dioxide; hunts for any possible gaps in clouds

Dish antenna rocks to scan Venus

Long-range antenna transmits observations to earth

## For Venus and Space Observations:

### MAGNETOMETER

Tells whether Venus has magnetic field like that of earth; also measures magnetic fields in space

## For Space Observations:

### COSMIC-RAY DETECTOR

Measures these rays and other radiation in space, with Geiger counters and globe-shaped ion chamber

### MICROMETEOR DETECTOR

Counts meteoric particles striking plate

### "SOLAR WIND" DETECTOR

Gauges flow of protons streaming from the sun

Antenna receives commands from earth

Solar panels provide electric power



the future. If the long-range reading actually comes from higher in the atmosphere—or is a false one, perhaps thrown off by an extraordinary concentration of electrons in Venus' ionosphere—close-in measurements will show it. As a double check, while the microwave instrument is taking the temperature at Venus' surface, the infrared instrument will take temperatures in its atmosphere.

Does Venus have water, vital to life as we know it? The microwave instrument should reveal that, too. If so, reception should be weak or nonexistent for the 13½mm wave length, which would be absorbed by water vapor in Venus' atmosphere. The other, 19mm wave length is unaffected by water vapor.

Similar telltale differences in the infrared instruments' two sets of readings should reveal whether Venus' atmosphere contains enough carbon dioxide to

account for an ovenlike surface temperature, by a "greenhouse effect." Carbon dioxide will mask the 10-10.8-micron band but not the other, providing the needed clue. By the same artifice, the instrument will seek to learn whether there are any breaks in Venus' cloud blanket, through which its surface might occasionally be glimpsed.

A third Venus-observing instrument, in a metal cylinder, is a magnetometer. It will tell us if Venus has a magnetic field like Earth's compass-attracting one. That will throw light, not only on the planet's interior, but also on whether it has magnetic storms, auroras, and radiation belts—a practical concern for any manned expedition to Venus. The magnetometer takes readings in space, too.

*Along the way.* As Mariner travels, still other instruments are measuring cosmic rays, the "solar wind" of protons streaming from the sun, and the abundance of speeding micrometeors. A



## Will Mariner solve these mysteries of Venus?

**"A FUZZY** white tennis ball"—so one observer describes the blank appearance of mysterious Venus, perpetually masked

in clouds, as in this Lowell Observatory photo of its sunny side.

What are the clouds made of? No one knows. What lies beneath, on Venus' surface? No one has ever seen. Whether there can be life on Venus has called forth a rapid succession of opposing views. Astronomers can tell us only a little about the mystery planet with any assurance:

Its 7,575-mile diameter makes it almost a twin of the earth in size. It is a near match in weight, and force of gravity, too. Nearest planet to Earth, it approaches within less than 26,000,000 miles of us—compared with 35,000,000 miles for Mars. It circles the sun in a year of 225 of our days.

In our night sky, Venus outshines all but the moon. To viewers through powerful telescopes, it goes through phases like the moon's, from a thin crescent to a bright disk, as it moves from the near to the far side of the sun. On rare occasions, a glow-

ing ring of scattered light can be seen completely encircling its dark side—one proof that it has an atmosphere.

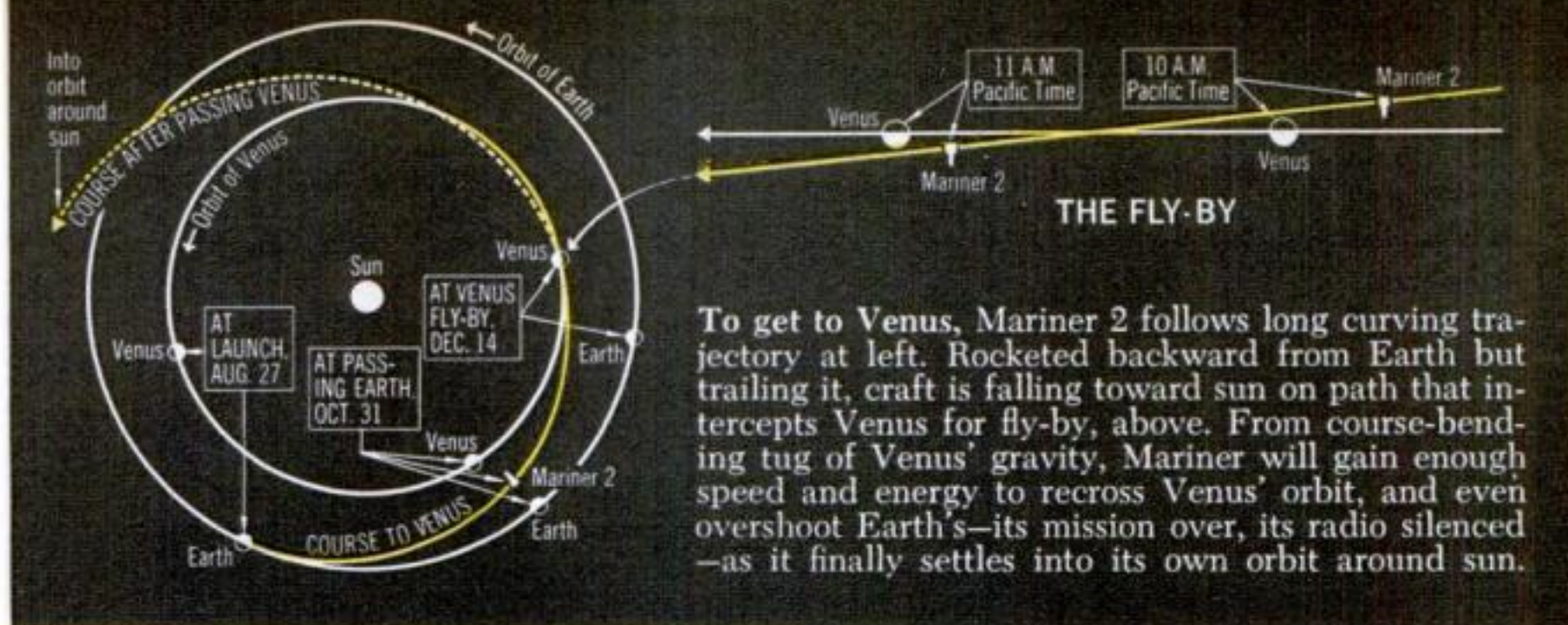
Vague markings, sometimes faintly seen on Venus' sunlit side, are believed only cloud patterns—and give no clue as to how fast the hidden planet turns on its axis, if at all. From various other evidence, estimates of the length of a day on Venus range as widely as from 22 hours to 225 days, by earth time.

No satellites of Venus are known. But it may have undiscovered moons, if they are as small as 7 to 15 miles in diameter, like Mars' two tiny ones.

What Venus' atmosphere is made of is crucial to the possibility of life there. Earth-based spectrographs show only that much of it, perhaps three-fourths, is carbon dioxide. Water, necessary to life, was looked for in vain until last year—when a 15-mile-high balloon-borne telescopic expedition found an inconclusive trace of water vapor in Venus' atmosphere.

Venus' hidden surface was formerly pictured as steaming swampland, something like the earth in prehistoric times. So there





crystal microphone counts pings of the meteors, like hail on a tin roof, against an exposed magnesium plate. One of Mariner 2's first notable discoveries: Meteoric particles are only 1/1,000 as numerous in deep space as near Earth—a happy augury for space travel.

Mariner's progress toward Venus has been steadily watched from Earth by three big radio telescopes. Spaced around the world at California, Aus-

tralia, and South Africa, they pass the task from one to another as the spinning earth brings each into position. By teletype, their tracking data and reports from the spacecraft stream into Mariner headquarters at the Jet Propulsion Laboratory in Pasadena.

At Goldstone, Calif., a tiny scientific community in a desert cupped by mountains, are two 85-foot-diameter

*[Continued on page 168]*

was a good chance, it was believed, of finding life on Venus—at least as good as on Mars, if not better. That idea followed from assuming that Venus' clouds, like Earth's, were formed from water.

By 1940, failure to find water vapor in Venus' atmosphere led to a new picture:

Venus was a dry desert, swept by violent dust storms. Its white-appearing mantle—actually pale lemon-yellow—consisted of clouds of the dust.

The 1950s brought rival theories. One radically disputed the idea that Venus was waterless. Venus' surface, it held, was completely submerged by an endless, watery ocean. By another theory, Venus' seas were of oil, and its clouds were oily smog.

As of today—pending reports from Mariner—all but the dust-bowl theory seem to have been wrecked by a recent bombshell:

Latest measurements from the earth put the temperature of Venus' surface at a searing-hot 600 degrees F. Dark and sunny sides depart by only a few degrees from this average figure. There seems no hope of a cool spot anywhere.

If this is positively confirmed, Venus' surface can only be a dry inferno—a wasteland hot enough to melt lead and tin. Any

water would surely have boiled away.

Since no imaginable form of life could endure such a temperature, it would mean that Venus is lifeless—and probably always has been. Equally, that could be said for the foreseeable future—for it is hard to imagine any protective clothing that could enable spacemen to survive a landing.

But astronomers still view the 600-degree figure with caution. What could make Venus so hot? Possibly the abundant carbon dioxide could have enough of a "greenhouse effect" (letting the sun's heat in, not out) but they want to be surer of the cause.

For another thing, the high reading is by a new technique—using a planet's natural radio emission, at microwave frequencies, to gauge its temperature. Elsewhere, as with Mars, this method's findings agree closely with earlier ones. In Venus' case they don't. Could anything be distorting the Venus readings? False ones could result, some suggest, from an exceptional concentration of electrons in Venus' high-altitude ionosphere.

Only closer-range observations can settle the most burning question about Venus—and hopes of getting them ride on Mariner 2.—Alden P. Armagnac.



# Blizzard Busters of Berthoud

Colorado's rugged new plows fight storms and whiteouts  
again as they claw their way over Rocky Mountain passes

By E. D. Fales Jr.

**I**T TAKES guts to push a plow up a 12,000-foot pass to the top of the world. I know. I've just ridden a plow up the edge of the Rockies and some of the time my hair stood on end.

All these passes are over 9,000 feet high. On 11,314-foot Berthoud and its 12,000-foot neighbor, Loveland Pass, 50-mile winds are common. And what's worse, great snowslides sometimes bury roads 25 feet deep.

Yet Colorado keeps these roads open when, elsewhere in the U.S., cities are paralyzed by three-inch snowfalls, and turnpikes crippled by ankle-deep snow. How come?

I put the question to Pat Murray, chief snow fighter in five great passes for an outstanding state highway department. He says: "Well, for one thing, our state backs us up with plenty of plows. In a bad storm we can send 100 men and 50 plows into these passes."

He adds: "Go ride up top and see."

**Ready for the blizzard run over two-mile-high Berthoud Pass, the author gets into the cab of No. 1500, Colorado's new Snowblast job.**

I do, first in a five-ton conventional-blade plow, then in Colorado's "secret weapon"—a \$62,000, 20-ton rotary that makes a mockery of the plowing many of us are used to. This turbocharged monster, called a Snowblast, has two engines.

Before I start up, Murray briefs me. "Our men's orders are: *'Hit snow the instant it falls. Never let it get ahead of you. Never let cars, or trucks, get down to the stall point—or you've got a plugged road. And never stop plowing until it's over.'*" Colorado has men who have plowed 72 hours without sleep.

I also learn: Pass-plowing on two-lane roads can be scary work. Now and then some plowman gives his life. "It's a job that draws only the best," Murray says.

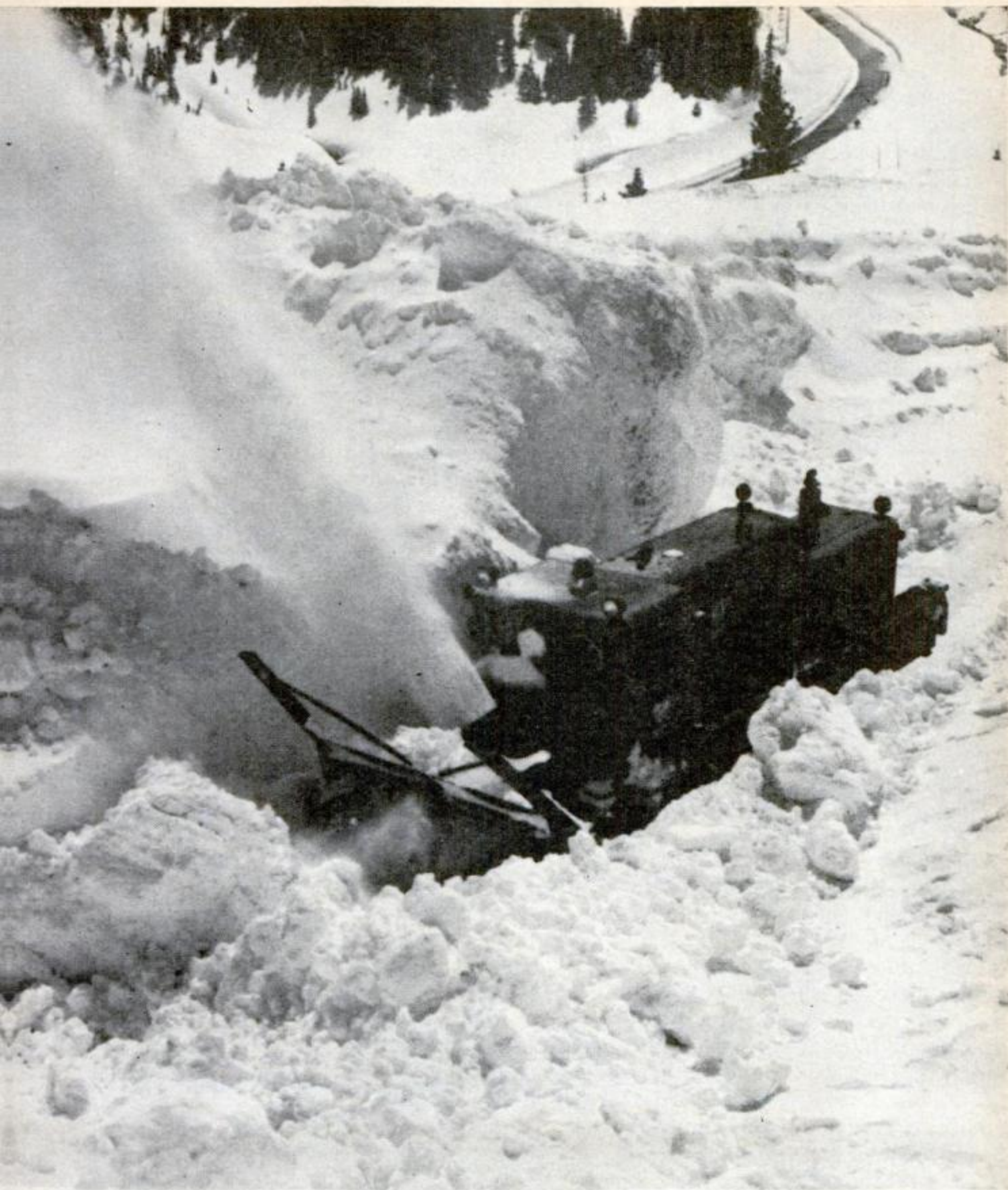
I find Plow No. 758 waiting in a snowy patrol base at the bottom of Loveland Pass, Atlantic side. A golden FWD truck with winking blue lights, it carries a mountain of sand.

I hike into the cab. A hand reaches across and a voice says: "Howdy, I'm Glen Ott." I've heard of Ott. Once an-

**Start of a frightening climb: Glen Ott takes the wheel of No. 758, headed for the Loveland Pass run, far out on the edge of dizzy cliffs.**







70-m.p.h. jet screams as two-engine Snowblast fights its way above tree line in 10-foot drift.

other plow "lost the edge" and came down like a yellow comet. Ott, grimly searching, found the fallen plow far below, driver dead.

*It's 11:30 a.m.* We start up U.S. 6. I look at the snowy mountain wall and am glad to see we're going up the inside

shoulder. Two danger flags wave from our headlights. Our blue blinker comes on. Ott hits a row of buttons. We light up like a Christmas tree. "I like to be seen," he says.

No. 758 is a five-ton, 190-horse job with four-wheel drive. She's classified



## This new rotary plow rams through windshield-high snowdrifts

high-speed, can skim three inches of snow off a prairie road at 30 miles an hour. But up here she raises her nose to the sky, tips back, and throbs up at 10 miles on frozen snow pack.

"Chains?" I say hopefully.

"Not with this load," Ott says. "We'd chew 'em off." He flips a toggle. An air valve whistles. "That's our twin-grip locking up," he says. "We'll need it."

*We zigzag up.* A stiff five-mile climb above us hangs the Pass, known respectfully here only as "the Loveland." To gain it, you ladder up Mt. Sniktau, which pokes up nearly three miles.

Far up, we see a red ant creeping down. "Trailways from Salt Lake," says Ott, "with a special mountain driver. Those boys are the greatest."

It isn't bad climbing because we are in a corridor and can't see height. Then one snow wall falls away and we're on a shelf looking down. No. 758 has five forward speeds plus high-low range. Total: 10 speeds. We are in low-fourth, coming up into fresh morning snow.

There are four rods under our dash: pneumatic controls. One swings the blade, another locks it; one raises it, one lowers it. Ott selects one and tugs. With a shock, the two-ton blade drops and levels off two inches above the permanent snow pack. We're plowing. A bright wave of snow flies. Ott pushes No. 758 into the first climbing turn. "Number 1 plow went up an hour ago," he says. "He's splitting the road down the middle, leaving a ridge on the right. Number 2 went up 30 minutes ago—should be near the top now."

"He's pushing the ridge over on the shoulder. Our job will be to go up the shoulder and buck it off the side."

We pass a car coming down without chains—violating the first rule of pass-driving. He's slewing a bit and then we see that the rear deck is open and he's put his passenger in the trunk—for traction. The passenger, buried in snow, is holding up the lid.

Then comes the Trailways, loaded with ice. Ott says, "Oh—oh! Storming up top. We're going to catch it."

No. 758 snarls upgrade, rocking and bouncing. Our speed drops. Ott says we're carrying 13 tons of sand, mostly for traction.

With a five-ton truck and half-ton blade, that makes 18½ tons. I'm adding this up when Ott swings us up a steep hairpin turn, and we lose our safe inside edge. Suddenly the mountain changes sides and we are out on what looks like the world champ of dizzy edges. The road simply hangs in space. I toss a dead cigar out the window. It just keeps going straight down. Now I know why plowmen don't put their best tires on the rear wheels, but on the outside.

To the north lies a jumble of peaks where U.S. 40 crosses the Divide in Berthoud Pass. There's also a lot of scenery a half mile from our treads—straight down. Only small guide sticks mark the edge—no rails.

Beside me, Ott is very quiet, balancing on the shoulder, steering by those sticks, clipping with uncanny skill within two inches of them. Trouble is: Some sticks had gone over. Where there are none I don't look down and just feel good to have a driver like Ott. Our blade takes the snow right to the drop-off place and it goes down in long streamers.

*At 11:50 a.m., 10,500 feet up,* it starts to storm. We come up into a white cloud. A hard wind booms from the depths. Our flags fly upward and begin tearing themselves to bits. The truck bounces. When the pushing gets heavy our wheels slip. Then the guide sticks vanish. Everything vanishes. Ott immediately downshifts to second low. This is the emergency that plowmen hate: a whiteout.

We're down to a crawl but still moving. "You can't ever stop," Ott says, "or the road plugs up."

Our wipers are loading up. To my relief, we now take to the center line.



without stopping



Pat Murray, boss of five stormy passes, watches from walkway while Carl Hicken double-steers No. 1500 for sharp turn on a narrow road.



In the cab, Hicken swings both steering wheels at once. Wheel at his side controls rear wheels. Lever with knob raises or lowers blade.

And so we become the lead plow, splitting the road open in this new storm. At 11:58 the No. 1 plow comes down, making a wave like a destroyer.

Ott says: "Sometimes the next mile is white hell."

And then No. 758 balks. I've been watching a little iron weather cap bouncing on the exhaust stack outside our windshield. We've come to a tight climbing turn. Ott has sort of thrown us into it—a neat maneuver to keep plowing speed. We're now in high third. Ott says, "Think she'll take it?"

First warning comes when the weather cap explodes wide open. No. 758 is going to refuse. Oily smoke blasts up. "Wants to lug," Ott says. "We've gotta shift."

**Downshifting No. 758 is quite a thing.** A stall can leave you hanging backward on brakes. Trouble is: The two floor sticks are together by the driver's right knee; the high-low ranger, or "brownie," and the main gearbox stick. Both are worked with the right hand. But for the quick shift we'll need, Ott won't be able to work both sticks at once.

In a flash, he drops the wheel, de-clutches, and right-hands the brownie forward from high to neutral. Simultaneously, he guns the engine, and rams his left arm down through the wheel to the shoulder to get the main stick. He finds it, yanks it back from third to second, then pulls his arm out of the wheel.

For a split second we hang there. Ott's right hand now flashes the brownie full-forward into low range. He eases in the clutch and pours on coal. After I've swallowed my gum, I gratefully feel our 190-horse diesel take us in tow again. The weather breaks for a moment and we look down on the white backbone of America. Then it snows like all get-out, and we are blind again.

We top the Pass at 12:15, having paused to offer help to a car carrier and two nervous tourists from Arkansas. I light a new cigar. "Glen," I say, "I was scared."

"Sometimes," he says, "we get scared, too."

**Going down.** From the screaming, near-zero top, we edge down the Pacific slope, followed by the tourists. Now we



roll faster. Snow flies in sheets. Uphill we had bucked snow; now we are coasting.

I ask: "Glen, what happens if the brakes fail?"

"I'd dive her for the mountain wall and wreck her," he says. "That's all you can do."

We pass the No. 2 plow eastbound. Ott says: "If this gets any worse Pat will have five plows working the Pass tonight. The trucks will be coming over."

"The trucks?" I said.

"The real traffic comes over between 10 p.m. and 3 a.m.," Ott tells me. "That's when Denver-Salt Lake schedules seem to put them up here."

Eight miles down on the Pacific side, No. 758, at 12:48 p.m., makes a wide turn and starts back up. There are 10 inches of fresh snow. The wind is getting wilder. On many roads elsewhere traffic would be crawling to a stop by this time.

But up here traffic is moving smoothly. At dark in a near-blizzard you can see the lights going over the top. Toward 10 the trucks begin coming up. Two fine clean lanes are open. There'll be no delays on the Loveland tonight, even though breakfast time will find 2½ feet of new snow—enough to paralyze level turnpikes.

Next day I join Pat Murray again and we start out in his pickup, with chains on, to find No. 1500—the new secret weapon, the Snowblast.

**Riding the Snowblast.** Nothing like the Snowblast ever has ridden U.S. roads. We find her pounding up the Pacific side of Berthoud Pass. Blasting a lane up U.S. 40 under her snow rainbow, she looks like a golden river boat with a flailing red paddle wheel. Except that the paddle wheel is up front. We can hear that rainbow—a 70-m.p.h. snow jet—whistling over. It thunders down into Fraser River Canyon and sets trees tossing.

This is a far cry from No. 758. Colorado now has two Snowblasts. Impressed, even the Denver & Rio Grande Railroad is thinking of getting one. And "back

East," New York's great Idlewild International Airport, after trying one, immediately ordered 11 more.

Here at last is "instant plowing." Carl Hicken, who drives No. 1500, lives at a wilderness base. In an emergency he "scrambles" like a jet fighter pilot. "I can be out of bed and on the road in five minutes after I get a call," he says.

I ride over the pass with Hicken. After No. 758, it is like changing from a DC-3 to a jetliner. We cruise up at 20 miles an hour, take time out to open an old road where snow comes to our windshield, then go up top. Our secret is our two engines and the thin helical "egg-beater" blade which keeps pulling us ahead.

We roar on up, pushed by a 220-horse turbocharged Cummins mounted aft over our rear wheels. Then Hicken drops a combination clutch-accelerator lever on the dashboard, and that rainbow jet explodes with a roar in front of our windshield.

Instead of bucking snow off the edge, we hurl it aloft. Our jet throws out, not 85 feet as older rotaries do, but 110. When we come to cliffs on our side, Hicken turns a valve; the exhaust chute (18 inches square) revolves and spits the jet out clear over the road. It goes up so high—30 feet—and in such a clean arc that cars pass right under it.

Sometimes the wind hurls snow back at us and our windshield loads up. Then Hicken starts the rotary windshield. Spinning at 2,400 r.p.m., belt-driven from a ½-horse motor in the cab roof, the glass disk whirls off all snow. "Not even freezing rain can stick to that windshield," Hicken says.

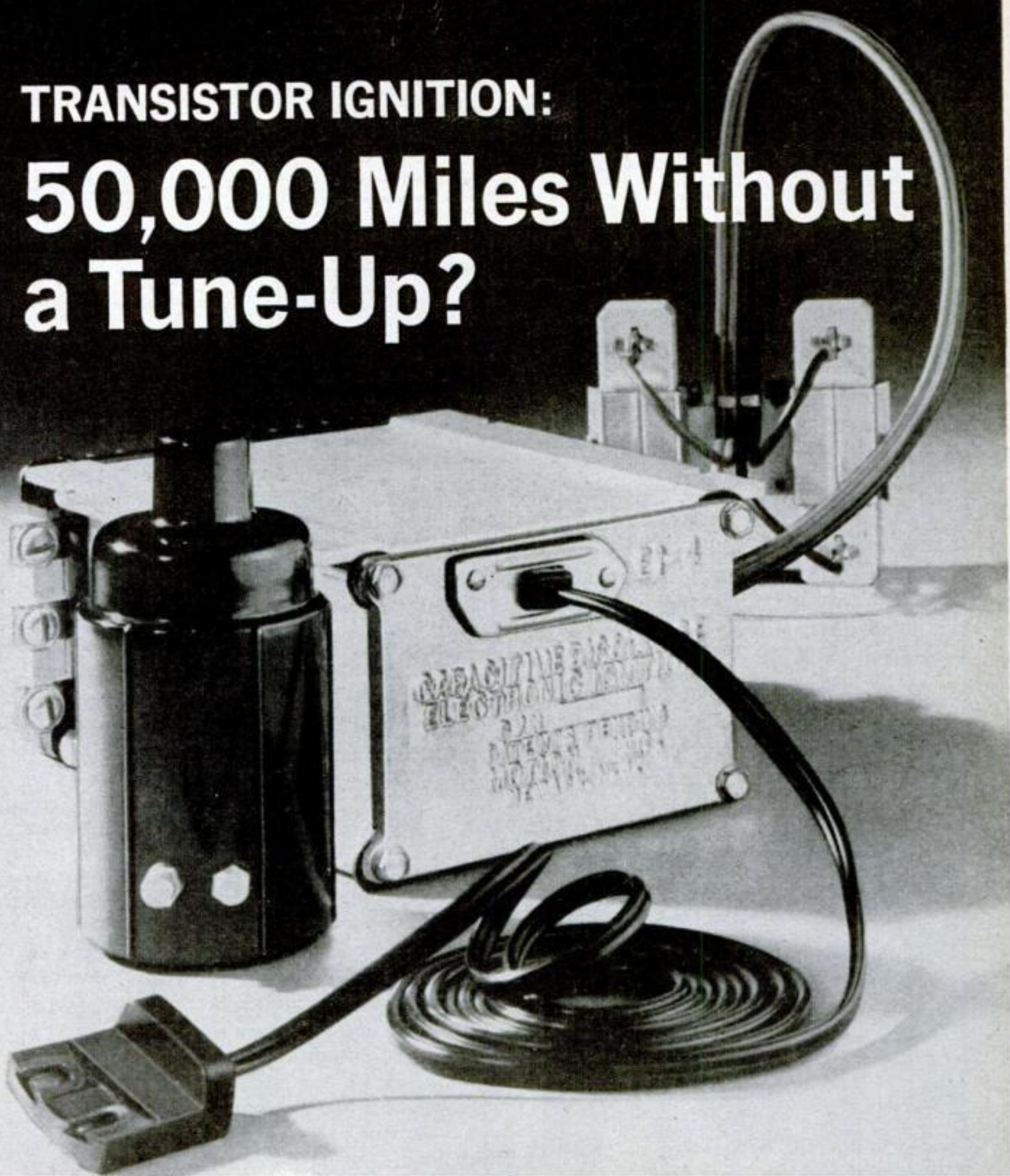
We come to a tight hairpin turn. With no warning, Hicken lowers a handle and unlocks his rear wheels. Then he grabs a second steering wheel down at his side between the seats.

**Twin-wheel steering.** He spins the two wheels at once. Our front wheels turn sharp right, the rear wheels sharp left. All 20 tons of us crab around in a snappy flying turn. No sports car ever

[Continued on page 190]



# TRANSISTOR IGNITION: 50,000 Miles Without a Tune-Up?



A capacitor discharge fires the plugs in Tung-Sol's EI-4 transistor-ignition system.

**By Hubert Lockett**

**O**UT in Detroit, engineers are fairly well convinced that it's about time to make the first basic change in ignition systems in 52 years. In the past few years they've explored the possibilities of a wide variety of sys-

tems—some have even shown up, tentatively, on a few car models. But until recently the consensus was that none offered enough all-around improvement at the price the customer would pay.

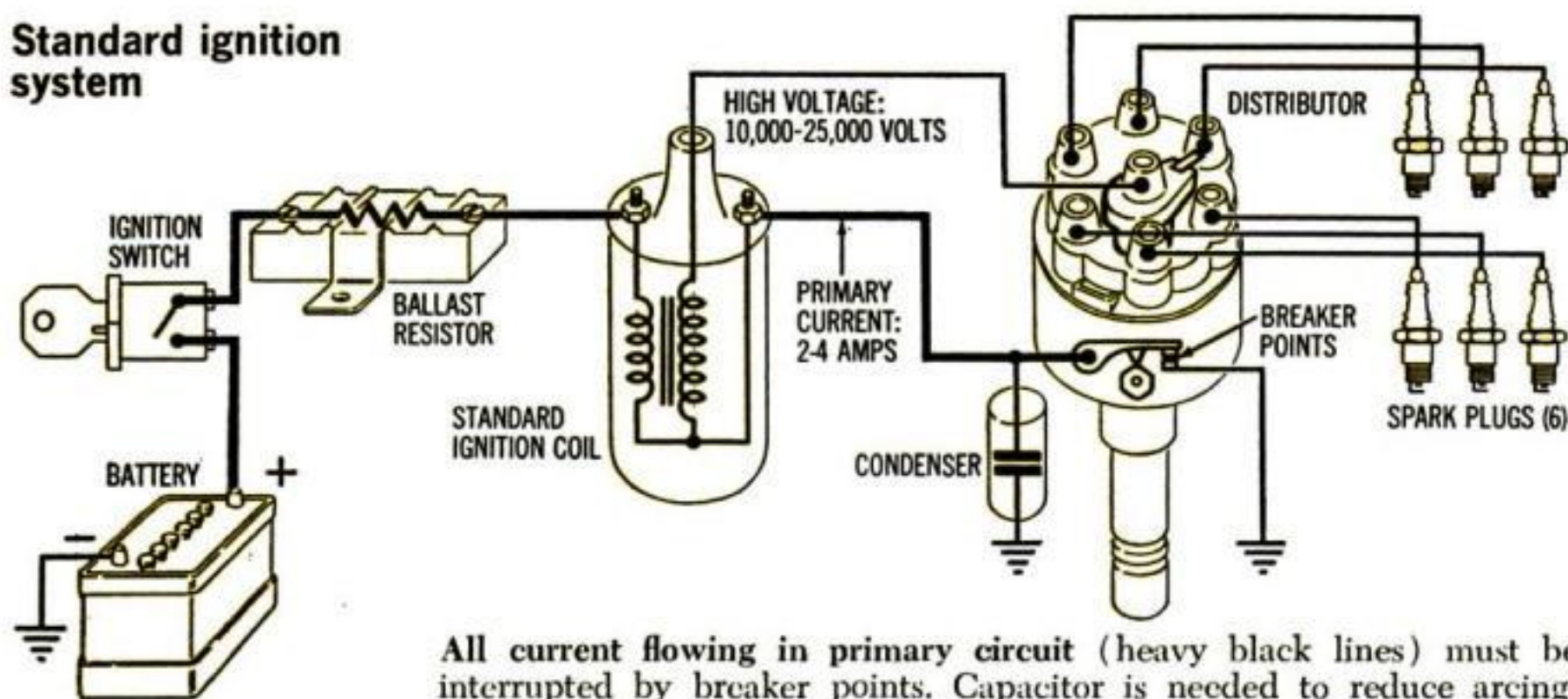
Now, the remarkable success of transistor systems on the after market, and the unmistakable trend in Detroit toward

CONTINUED

53



## Standard ignition system



All current flowing in primary circuit (heavy black lines) must be interrupted by breaker points. Capacitor is needed to reduce arcing.

a car that will run 25,000 to 50,000 miles without service, have added urgency to their search. Everyone seems to be concentrating on some version of a transistor system. The only remaining question to most auto makers is when.

You can buy a transistor system now on a Pontiac or on a Ford truck. Ford and Mercury plan to have one available for their 406-cu.-in. engine beginning about January 1. Later in the model year Thunderbird will offer transistor

ignition on the six-barrel-carb engine. Corvette had planned one for this year, but reports are now that it has been postponed until next year.

These are but the first feelers, the beginnings of a trend that informed observers believe will sweep the industry by 1965—unless unforeseen bugs crop up.

If you don't want to wait, there are a number of transistor-ignition systems on the market that you can buy and install yourself. Prices range from about \$30 to



## A personal-use report

**T**O FIND out, first hand, just what to expect of a transistor-ignition system, I installed a Transigniter 201 (Electric Autolite Co., Toledo, Ohio) on my Dodge Lancer. This sells for \$78 and change at local Prestolite dealers.

I had seen a number of demonstrations, observed lab tests, and talked to a variety

of engineers; but I wanted to see what problems, if any, developed when I installed one myself and lived with it.

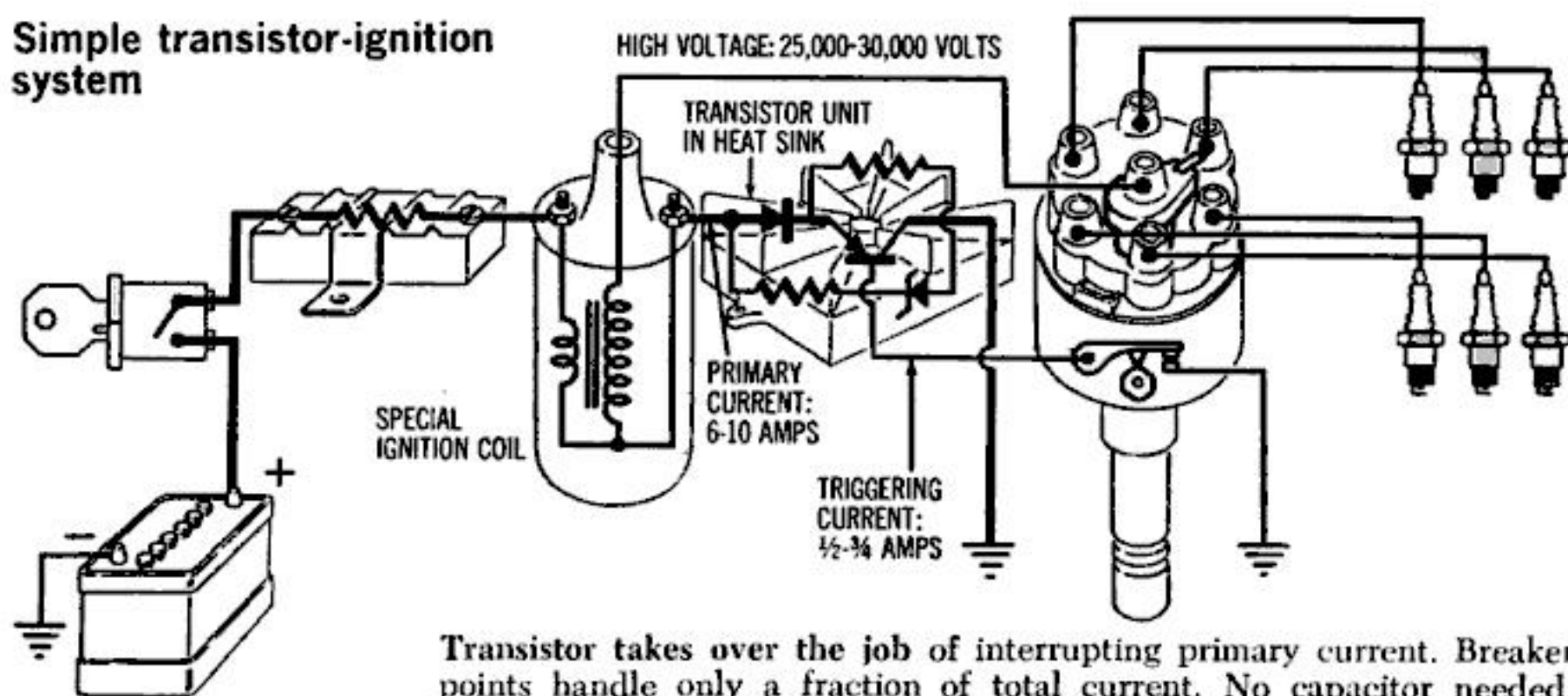
The package I got contained a finned transistor unit with a long two-wire-plus-ground-lead cable attached. Each wire had a terminal lug and a label. There was a coil, with a mounting bracket, identical in appearance to a standard coil. A ballast resistor, a primary connecting wire with lugs attached, and a handful of self-tapping screws with washers were also included.

It took me about 45 minutes to study the instructions and install the system. I mounted all the new parts on the fender well near the distributor. Instead of removing the old coil, ballast resistor, and condenser in the distributor, I left them in place, disconnected them, and taped the exposed leads. The two leads to the old ballast had to be connected, of course. Now I can go back to the standard system with about two minutes' work any time I want to compare performance.

When I had tightened the last connection



## Simple transistor-ignition system



Transistor takes over the job of interrupting primary current. Breaker points handle only a fraction of total current. No capacitor needed.

\$125. They'll fit just about any car and take less than an hour to install.

**Why transistor ignition?** The weakest part of your car's engine is the ignition system. Its durability simply hasn't kept pace with other engine developments. The breaker points, particularly, have been pushed to the limit in trying to meet the spark needs of modern, high-compression engines.

The only way to get more spark energy out of the present system is to send more

energy into it. The input current is interrupted by the breaker points some 12,000 times for every mile you drive. At the present levels of three to four amps, points are handling all they can take and still give a reasonable life of 2,000 to 5,000 miles before replacement.

But frequent replacement of points is not the only problem. As the contacts separate, all the current tries to squeeze through the last microscopic area of contact. Current density exceeds an unbe-

CONTINUED

and rechecked the wiring, I started the engine. It idled a bit roughly. I fiddled with the idle adjustment on the carb and the engine soon settled down to a silky smooth purr—smoother than I had ever been able to get it to idle before. I was delighted, but the pleasure soon turned to frustration.

**I went out for a road test.** The first steep hill I came to, I downshifted, planning to see how she would go on an all-out hill climb. The engine sputtered, bucked, and refused to respond to the throttle. Back home I hooked up the ignition analyzer and found that cylinders numbers 1 and 4 were misfiring under load. New plugs. Same story. New wires. Same story. I remembered that the week before I had had similar trouble after leaving the car out in a downpour, but it had cleared up after a few miles and I had forgotten about it. Next move: new distributor cap.

The car roared up my test hill as though headed into orbit.

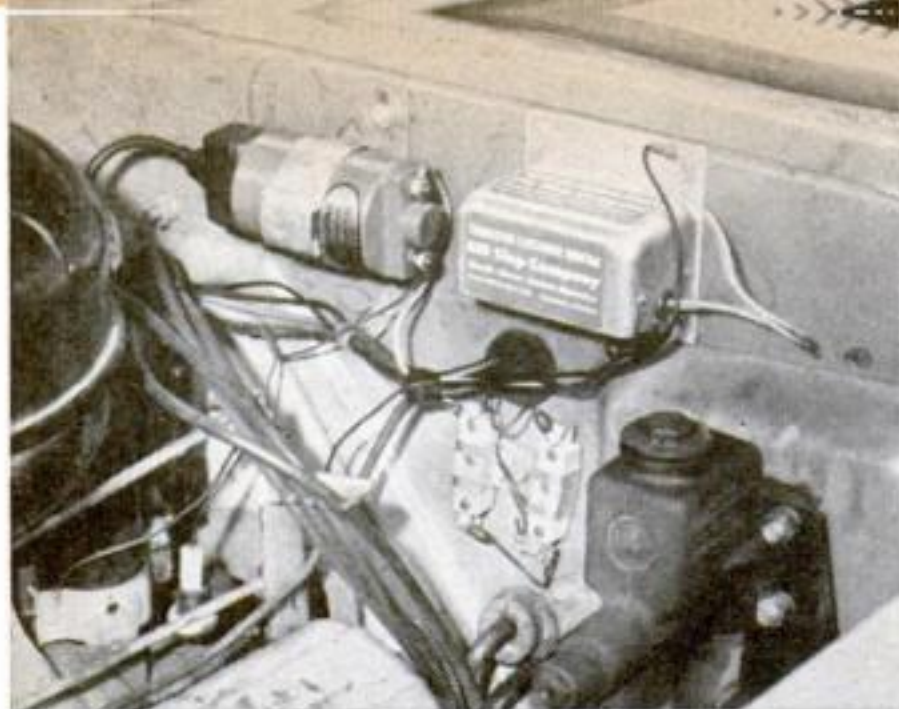
I could see nothing wrong with the old cap, but evidently there was a fault that

showed up under the stress of the higher voltage.

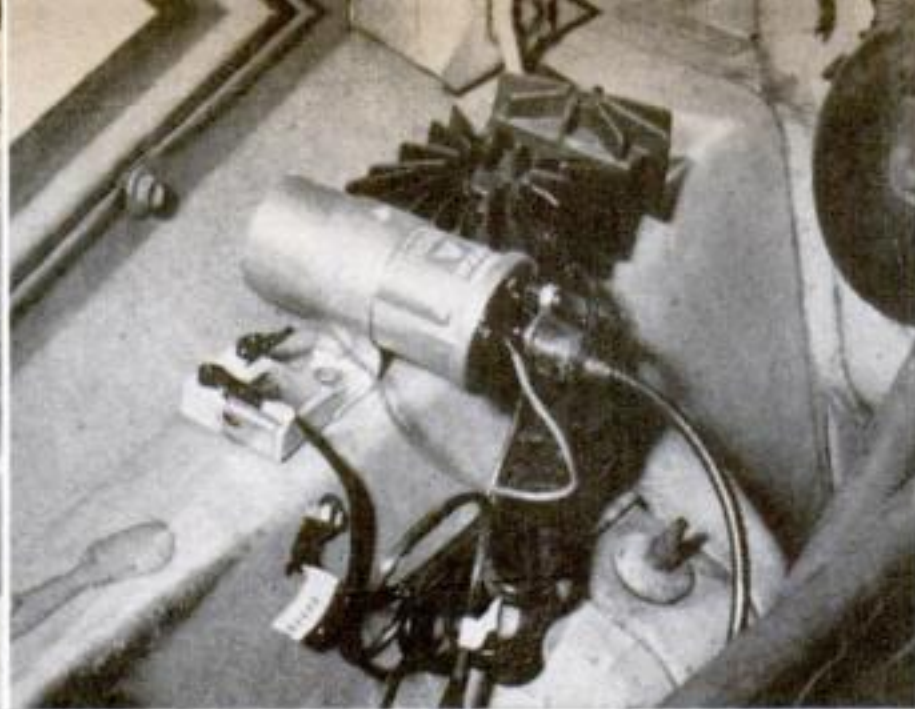
After that, I tried every trick I could think of to give the new system a workout. I installed an old set of plugs that had been run 20,000 miles. The gaps measured .045" and the electrodes were worn and rounded. The engine started easily and wound up to top speed without a miss. I had another driver behind the wheel for these checks so I could watch the analyzer closely. The scope analyzer, of course, would reveal a random miss that you might not otherwise notice.

With a nearly new set of plugs, gapped to .045", and the timing advanced slightly from the position I had found best with the old system, I got about a 10-percent improvement in gas mileage for suburban driving. I have not found a significant gain in economy for high-speed driving. I did, however, shave about 1½ seconds off the 0-to-60 time. And, for whatever it's worth, I can chuff along smoothly in high gear at 4.5 m.p.h.





**Firewall mounting** is a popular way to install add-on transistor systems. Only other thing you have to do is remove the capacitor from the distributor. This is a Slepionic TS-14.



**Fender well** is another good mounting place. Transistor unit should be kept away from exhaust manifold and as far from engine heat as practical. This is a Transigniter 201.

lievable million amps per square inch. Heat generated at this tiny spot (over 6,100 degrees) will melt the tungsten contact button. The molten metal pulls apart like taffy, actually prolonging the electrical connection after it should be interrupted. Engineers call it "bridging." Even after the physical connection is broken, the current may arc across the air space. The erratic nature of bridging and arcing causes slight inaccuracies in timing which, in turn, cause engine roughness.

Most car buffs are familiar with the problem of getting enough spark at high speed. When the points close, energy is built up in the coil. This energy is released suddenly when the points open, delivering high voltage to fire the spark plug. But at high speed the points don't remain closed long enough for the energy to build up to a maximum, so the spark voltage drops. If your plugs are worn there may not be enough voltage to fire them reliably, and you get a gas-wasting, high-speed miss.

Transistors allow a two-pronged attack on these problems:

1. They can take over the heavy-duty switching job. Typical systems now on the market handle from 6 to 10 amps.
2. They permit a different coil design that can store ample energy in a much shorter time than can conventional coils.

**How it works.** The transistor has the remarkable ability to switch currents without moving parts. The semiconductor element in it can act as either an

electrical insulator or an electrical conductor with only a small change in triggering current. It may switch a current as much as 30 times as large as the current needed to trigger it. Since there are no moving parts there is nothing to wear out.

In most present transistor systems the triggering current is supplied by the conventional breaker points in a standard distributor. But this current is so low ( $\frac{1}{2}$  to  $\frac{3}{4}$  amp) that it is easily handled with negligible strain on the contacts.

There is more to it than just wiring a transistor into your present system. When the primary circuit is interrupted, there is a high-voltage kickback from the coil. This voltage is enough to destroy any presently available transistor. So circuits had to be devised and coil design changed to keep this kickback voltage within safe limits. Also, transistors are easily damaged by excess heat. They generate heat themselves that must be disposed of and they have to be protected from engine heat. Large heat-sink mounts with cooling fins have been the answer to the first heat problem, and care in locating the unit, to the second.

**What will they do for you?** Some exaggerated claims made for transistor-ignition systems have led to disappointment. But there are solid, worthwhile advantages to many car owners.

One big difference is that you don't need tune-ups as frequently. Typically, your car will run 25,000 to 50,000 miles—as well as it does now immediately aft-



er a tune-up—without an ignition tune-up. If you've been lax about tune-ups, you'll notice a modest improvement in overall gas mileage.

Performance will be better, too. Your engine will run more smoothly at idle and when lugging at moderate speeds. It's not uncommon to be able to perk along at five m.p.h. in high gear without bucking and stalling. In most cars you can open the plug gaps to .045" or .050" without running into high-speed miss. This dodge usually improves gas mileage in the range below 40 m.p.h.—although you won't realize the maximum advantage of the juicier spark unless you are willing to experiment with leaner jets in your carburetor. At the top end you can usually count on adding from three to eight m.p.h. to the top speed.

Even the ladies will appreciate the improvement in cold-weather starting. With standard ignition systems one of the most annoying problems is "blue points": When the engine turns over slowly, the points remain closed long enough for the heavy current flowing through them to overheat the tungsten contacts. The hot tungsten oxidizes and the contact becomes coated with a blue oxide film which is an electrical insulator. It can prevent further current from flowing and make it impossible to start the car until the points are filed or replaced. It can't happen with transistor systems since the current through the points is quite small.

**What you should know.** There are three kinds of transistorized systems now in use. The simplest type, described earlier, is the most common. It uses the standard distributor points to trigger the transistor and the discharge from a special spark coil to fire the plug. This is the kind used by Ford and by most of the owner-installed systems.

One premium-priced system (Tung-Sol's EI-4) uses a capacitor discharge to fire the plug. It also uses a transistor triggered by standard breaker points and a high-voltage coil, but the high voltage is rectified and stored in a capacitor until the instant of firing. This gives a

faster voltage rise. The advantages claimed for this system are a greater ability to fire badly fouled plugs and the possibility of more precise timing.

The third type lends itself best to original factory installation since it requires a special distributor. So far, only Pontiac offers it as an option. The main difference between this and the first type is that the transistor is triggered by a magnetic pulse generator in the special distributor. There are no mechanical contacts to make and break. Breaker-point and rubbing-block wear, as well as point bounce, are completely eliminated. ■ ■

## PS teach-yourself chase

**STARTS ON PAGE 60**

**G**

### A THEOREM IN NUMBER THEORY

By Norman A. Crowder

In this sample we shall prove a curious little theorem about the divisibility of certain numbers. Before we begin, however, let's get our terminology set. When we say that 24 is divisible by 6, we mean, of course, that dividing 24 by 6 **leaves no remainder**. In the same way we would say that 29 is **not** divisible by 8, since dividing 29 by 8 leaves a remainder of 5.

Now here is a question on what you have just read. Pick what you think is the right answer to the question and turn to the page number given with that answer. The question is: As we have been using the word "divisible" is 11 divisible by 4?

	BOX	PAGE
Yes	I	63
No	O	170

Your answer was:

**H**

If  $m$  is an even integer, the quantity  $m(m + 1)$  is not even.

You must have been thrown off by the fact that if  $m$  is even,  $m + 1$  is odd. But the product of an even number and an odd number is even, isn't it?

Now return to Box A, Page 10, and try again.

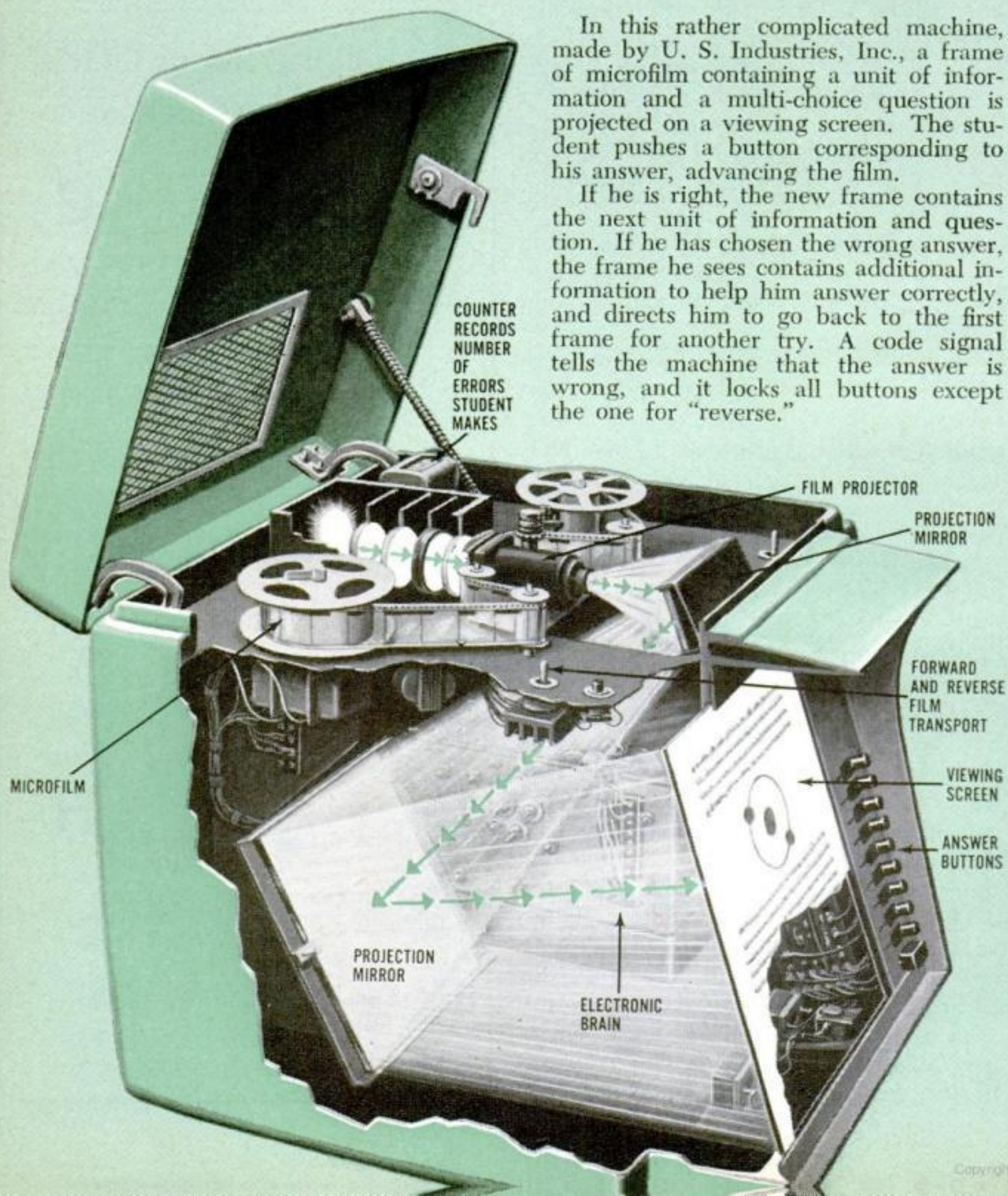




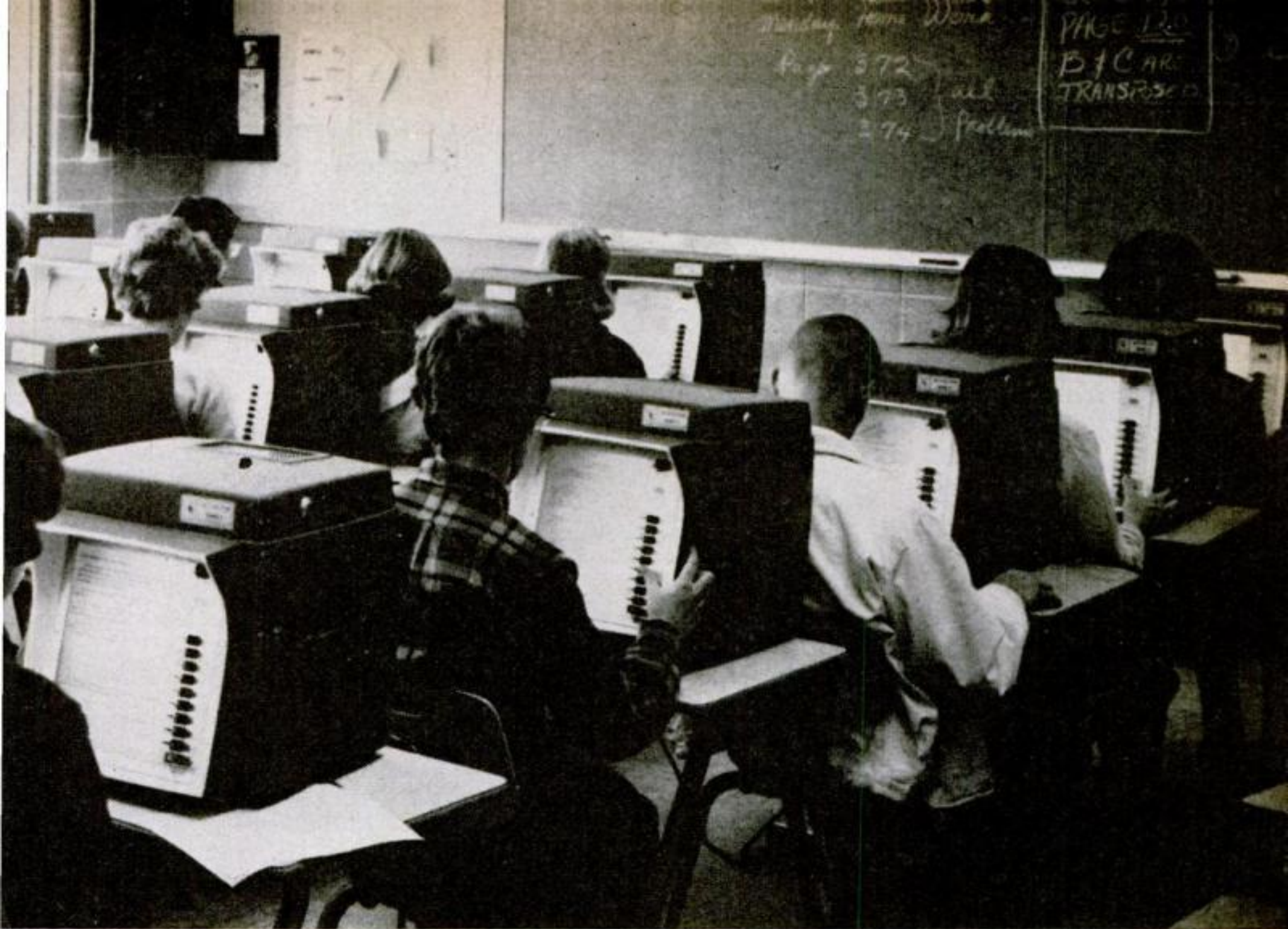
## Inside a teaching machine—and how it works

In this rather complicated machine, made by U. S. Industries, Inc., a frame of microfilm containing a unit of information and a multi-choice question is projected on a viewing screen. The student pushes a button corresponding to his answer, advancing the film.

If he is right, the new frame contains the next unit of information and question. If he has chosen the wrong answer, the frame he sees contains additional information to help him answer correctly, and directs him to go back to the first frame for another try. A code signal tells the machine that the answer is wrong, and it locks all buttons except the one for "reverse."







By 1965, predicts one authority, half of all U. S. students will make use of machines.

# Teaching Machines

## —Do They or Don't They?

Robot teachers are stirring up more to-do in education circles than anything since the invention of chalk

By C. P. Gilmore

**I**N ROANOKE, Va., 34 eighth graders recently took a weird course in algebra. There were no lectures, no homework assignments, no class discussion. Instead, for 50 minutes each day, the pupils turned knobs on portable-phonograph-size boxes, wrote answers on a roll of paper that appeared at a small window.

In one semester, the average student had completed a year's work. And in the

standard achievement test, most did better than the national average of students who'd studied the regular way.

Responsible for the stepped-up learning: teaching machines—mechanical or electronic contraptions, or sometimes specially designed books called programmed tests which go about teaching in a brand-new way. The robot teachers get results. For example:

- At Hamilton College in Clinton, N. Y., students in logic cut class time by a third, scuttled homework, still covered

CONTINUED

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Teaching machines range from the simple mechanical to the



**Simplest machine** is hand-held. Read question. Put stylus in slot corresponding to answer. If you're right, card advances to next question.



**Electronic machine** is teaching this student how to operate an IBM key-punch machine. Unit at rear records right and wrong punches.

more ground and made better grades than other classes.

- Seventy-four students at New York's Collegiate School romped through a course in advanced math in two weeks. Their classmates, learning the regular

way, spent two months on the course.

Industry is putting teaching machines to work, too, and getting the same eye-opening results:

- Two groups of Bell Laboratories technicians were taught electricity—one

## TRY THIS REAL TEACHING-MACHINE LESSON

# PS teach-yourself chase

**start here** → **T**O SEE how teaching machines work, try out the POPULAR SCIENCE "Teach-Yourself Chase"—a series of 13 boxes scattered on different pages of this issue. Even if you are not highly trained in mathematics, it will teach you, and prove, an interesting theorem in number theory. (And if you *are* an expert, make mistakes and see what happens.)

The material in the Chase is adapted by special permission from a demonstration of "branched programing," developed by Norman Crowder for U. S. Industries, Inc.

**All set? Then turn to page 57**



complex electronic—but none are better than their programs



**Machine with windows:** You write answer in small window, and turn knob. Black shield in large window lifts, revealing the correct answer.

by regular methods, the other by machine. The machine group did better on the final exams and remembered more when retested six months later.

- DuPont found that machinist trainees learned to read blueprints and mechanical drawings better and faster with machines.

- Eastman Kodak now uses teaching machines to train employees in logarithms, economics, basic photography, industrial relations, and use of the slide rule.

Modern teaching machines got their start during World War II in what must have been one of the strangest projects of the war. Allied scientists were working to perfect a guided missile, but couldn't come up with a workable guidance system. They asked Harvard psychologist B. F. Skinner to see what he could do.

**School for pigeon pilots.** Skinner set up a screen with a luminous spot in the center, trained pigeons to peck at the spot if it drifted off center. The object

was to put a pigeon in a missile and aim it at a target. A lens system in the nose would focus a picture of the target—a ship, for example—on a screen in front of the pigeon. As long as the missile was on course, the picture of the ship—a luminous dot—would be in the center of the screen. If it started to drift off, the pigeon would peck at it. The pecking would control servo motors and put the missile back on course.

The war ended before Skinner's pigeon pilots got off the ground, but the work wasn't wasted. During the experiment, of course, Skinner needed scores of trained pigeons. Lacking the time and staff to train them individually, he built a machine to do it. The machine automatically rewarded the pigeon with a grain of corn every time it pecked the right spot.

Through many hours of experimentation, Skinner had deduced several important teaching principles. He saw no reason they couldn't be applied to human learning.



Essentially they boil down to this:

1. Break the material to be learned into a series of tiny steps, each of which can be absorbed easily.

2. Require participation of the student; that is, make him answer a question at each step.

3. Let him know immediately whether he is right or wrong, and reward him if he's right.

Skinner built a machine to put his principles into operation. Here's how it worked. Turn a knob and a bit of information appears in a window on the front of the machine. Next comes a question on the material just presented. Write the answer on a roll of paper that shows through another window. Then turn the knob again. The right answer comes up in the first window and at the same time a piece of clear plastic covers the written answer so it can't be changed. Then on to the next question and answer. Skinner tried the machines on his students and got good results.

Just as educators were beginning to take notice of Skinner's theories, Sputnik sailed into orbit, and school officials began to cast around feverishly for new and better ways of educating the country's youth.

**The boom.** Within a few years, thousands of teaching-machine projects were underway across the country, and reports of startling results began to come in. The mechanized mentors became the hottest thing in education.

The only serious challenger to Skinner's idea among teaching-machine boosters is psychologist Norman Crowder. He bases his machine programs on a somewhat different principle. In a Crowder program, bigger hunks of information—perhaps a paragraph or so—are given the student at one gulp; then he's asked a question to see if he understands. If so, he goes on to the next point. If he misses, he is given more instruction on the point, then asked the question again. Thus, students who learn with a minimum of instruction skip all the additional help, but it's there for those who need it.

Programed learning—the basic prin-

ciple behind both Skinner's and Crowder's machines—actually doesn't even depend on the use of a machine at all. Specially designed books, totally unlike today's texts, can present the same information in the same order. The student is asked a question, writes the answer, then turns the page to check his answer.

The programed learning gives a series of important fringe benefits. In either the Skinner or Crowder method, for example, each student goes at his own pace: Bright students zoom through the courses in a third of the time taken by their classmates. The brighter students aren't bored; and slower learners don't give up because they can't keep up with the class. Tests have even shown, in fact, that the slower learners, although they take longer, may learn as much as the faster students.

Walk into a high-school class in first-year algebra at the Nutley, N.J., high school and see programed instruction in action. The first thing that strikes you is the quiet. Thirty students sit bent over programed texts. The only sound is the soft ripple of pages being turned.

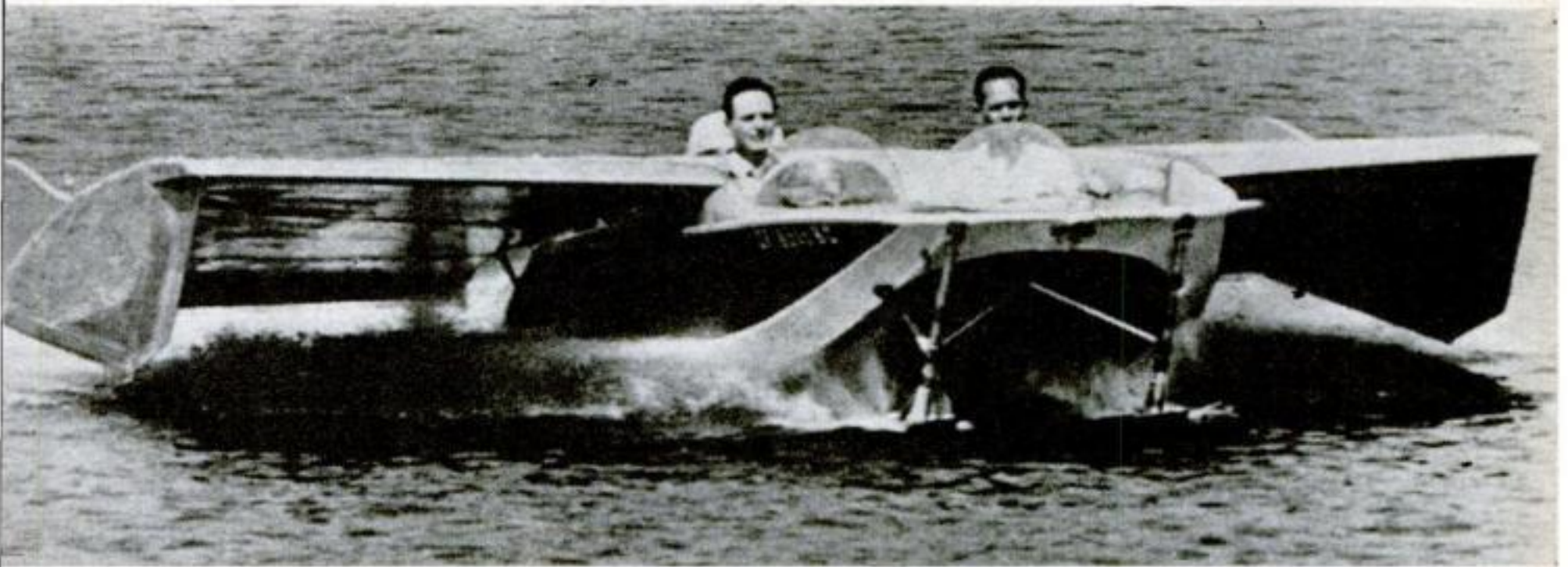
Max Kletter, the teacher, spends his time off in a side room holding conferences and answering questions. He gives individual attention to slower learners who need it, explores advanced concepts not covered in the course with the brighter students. "I feel I am teaching students instead of classes," he said.

**The proof.** The results prove his point. Ordinarily, Kletter's students would earn about 10 As and Bs, 25 Cs, Ds, and Es. This year, he gave 27 As and Bs, 7 Cs. No Ds or Es. "Some of those kids had never seen a B before," he said.

Of course teaching machines aren't going to make honor students of everyone. But educators hope they may help reduce the appalling number of dropouts—kids who fail to finish school. One reason for dropouts: frustration. Slow learners tend to fall further and further behind the class, until they feel hopelessly lost and want to quit school. The machine, which lets every student go at

[Continued on page 166]





## Winged boat skims the water

Wings at the sides of this experimental boat and skis under its bow make it 50 percent faster than a similar craft without wings. Powered by a 50-hp. outboard, with only the propeller under water, it skims the surface at 50 m.p.h. Air trapped under the wings provides a cushion that eliminates friction and wave resistance.

Lockheed engineers see it as a forerunner of large air-prop-driven cargo vessels that will fly close to the water at cruising speeds up to 230 m.p.h., faster than any conventional sea vessel and much more economical than airliners.



## Homey camouflage for the Army

Canvas, mud, and a thatched roof are used by troopers of the U. S. First Cavalry on duty in South Korea to hide their armored personnel carrier from spies. Chickens scratching beside it add to its appearance as a village hut. The roof at one end lowers to provide a clear field of fire for a turret-mounted .50-caliber machine gun.

## PS teach-yourself chase

**STARTS ON PAGE 60**

Your answer was:

11 is divisible by 4.

We were using "divisible" to mean "divisible without remainder". Dividing 11 by 4 leaves a remainder of 3, i.e. 4 "goes into" 11 twice, with 3 left over. So we would not say that 11 is divisible by 4.

Now return to Box G, Page 57, and try the problem again.

Your answer was:

$$(3x + 2)^2 = 3x^2 + 12x + 4.$$

You did fine except for one little detail. When you squared the term  $3x$  you squared the  $x$ , but not the 3. In general, if you have a term which is itself a product, such as  $ab$ , the square of that term is the product of the squares of its factors, i.e.

$$(ab)^2 = a^2b^2.$$

If one of the factors is a numeral and the other a literal number, as  $4z$  for example, you would proceed as follows:

$$(4z)^2 = (4)^2(z)^2 = 16z^2$$

Now you should be able to return to Box E, Page 26, and square the term  $3x$  correctly.





### A baby sister for the Triumph TR-4

The Triumph Spitfire 4 has a separate chassis with all-independent suspension, an Italian-styled body with bolt-on fenders to simplify replacement, and a detachable windshield for competition. The dual-carburetor 70-inch engine delivers 63 hp. Top speed: 90-plus. The roadster has a 24-foot turning circle, smallest of any car.



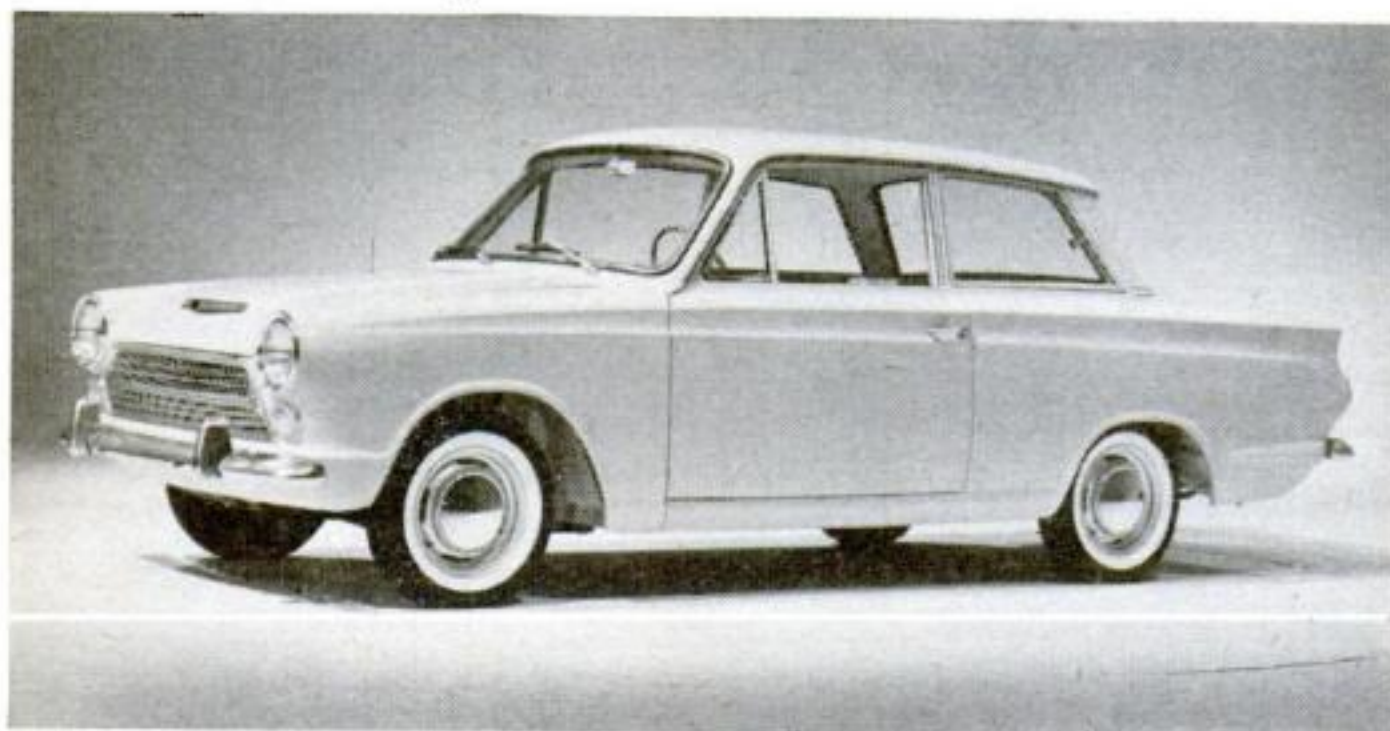
### New look for the MG sports car

A straight, crisp body reminiscent of the MG Midget and increased engine displacement are the big news on the MGB. The 109.6-inch four puts out 94 hp., resulting in improved acceleration and 107-m.p.h. top speed. The car is 2.1 inches shorter than the MGA. Roll-up windows, side vents, locking doors with outside handles are new.

## Latest Sporty Cars from England

British sports cars are becoming more civilized and comfortable and the sedans roomier and more luxurious, judging by the latest examples to reach our shores.

A few of the features offered (with an



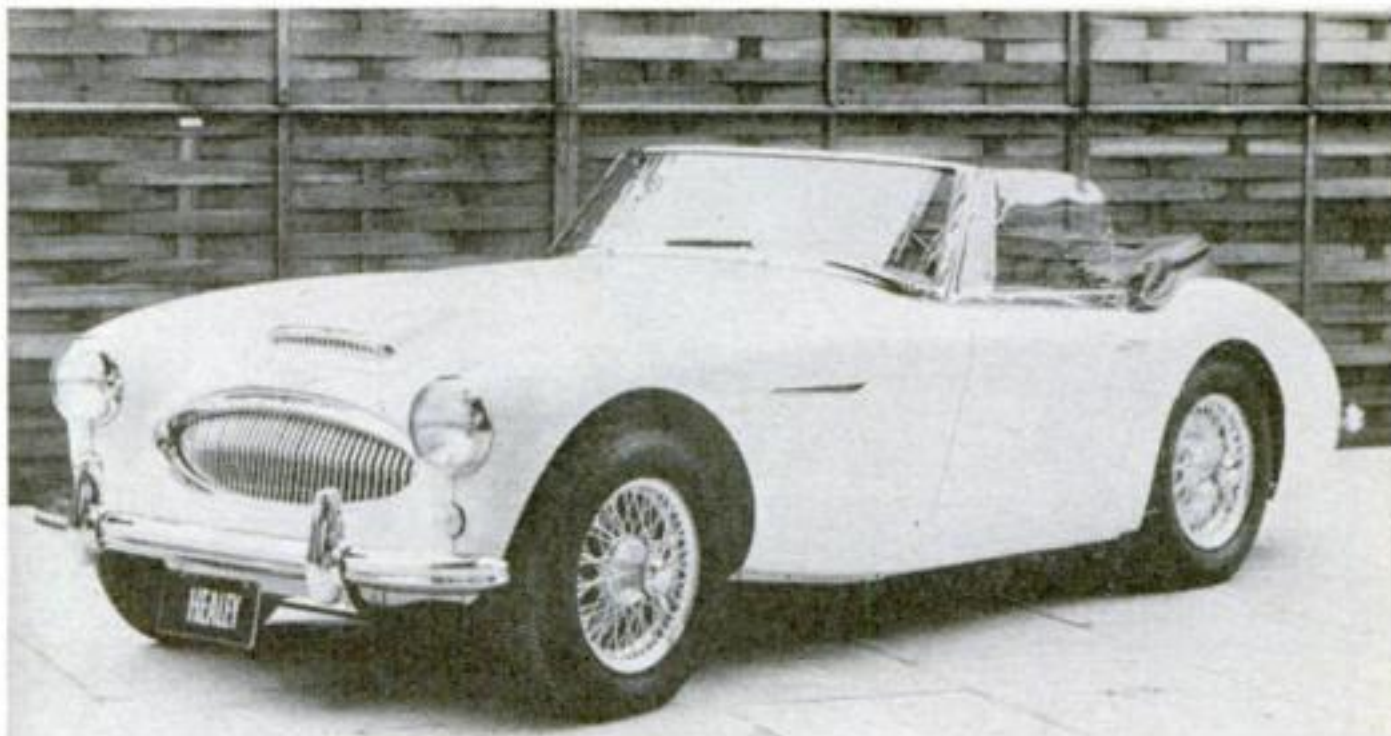
### English Ford's sprightly sedan

The Consul Cortina is derived from the Anglia and Consul 315. The engine is a 73-inch, 53-hp. four. The four-speed manual gearbox is fully synchronized. The unitized body is 168.3 inches long overall. Oil-change and lubrication intervals of 5,000 miles are recommended. List price is \$1,678 P.O.E.



## Big Austin Healey goes convertible

Though the body and running gear remain basically the same, the Austin Healey 3000, formerly a roadster, now sports roll-up windows, hinged side vents, wraparound windshield, and one-piece top. In place of the three carbs used in 1962, there are two larger ones. Easier to adjust, says BMC. Front springs are firmer. List price: \$3,535.



## Elva designed for Americans

The Elva Courier is a limited-production two-seater that combines an MGA 99-inch engine with Triumph Sports Six front suspension and steering. The tubular space-frame chassis is covered by a fiberglass body; detachable hardtop is optional. A refined version with independent rear suspension, MGB engine, will appear in January.



eye on the U. S. market): Convertibles are now getting roll-up windows (in place of the old clumsy and drafty side curtains) and tops that can be raised in seconds. Deluxe features are appearing, such as vinyl

interiors and wooden dashboards. Performance is being improved.

A trick that several British manufacturers have picked up from Detroit is the annual face lift.

## New MG sedan rides on water

A unique "Hydro-lastic" suspension consisting of water-filled rubber cylinders is said to give the MG 1100 an exceptionally good ride. The 67-inch transversely mounted engine develops 56 hp. and drives through the front wheels. On the way: a similar Morris 1100 with different grille and trim, detuned 48-hp. engine.

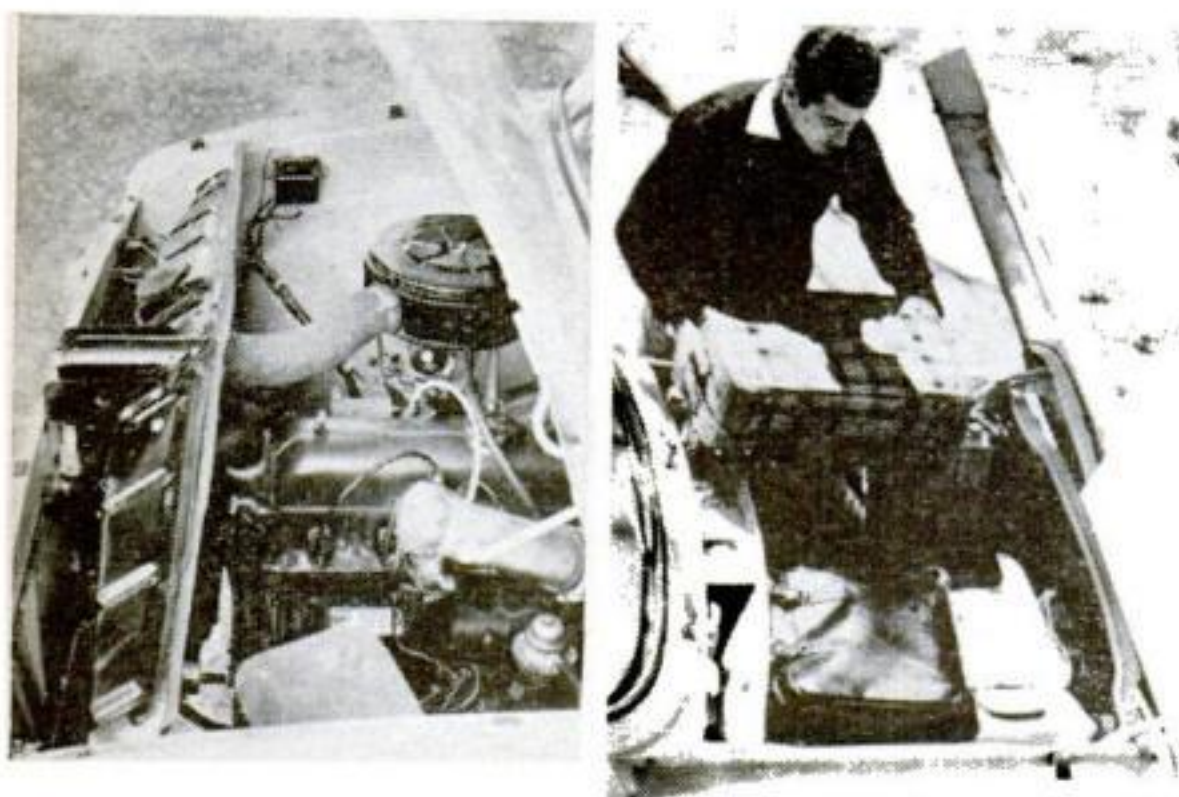




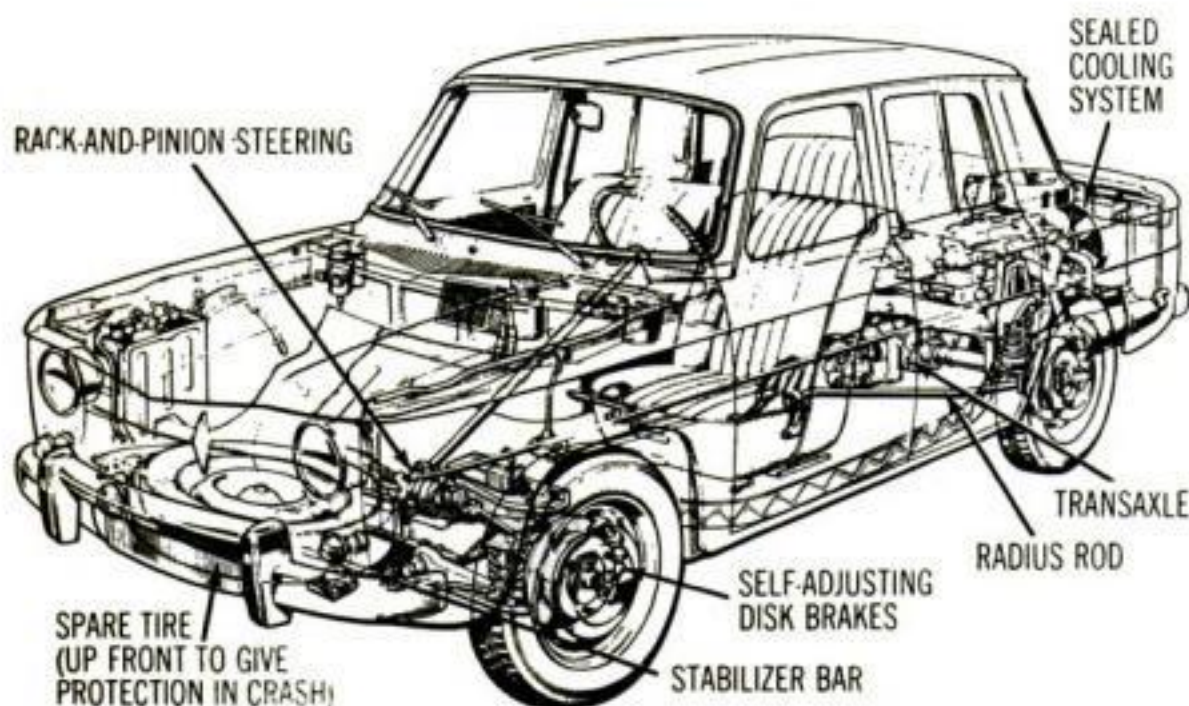


R-8 was designed with French *oo la-la* and an eye on U.S. sales.

## A Renault with an American Accent



Radiator is behind engine in R-8. Air is sucked in at top, expelled out the bottom. Trunk (at right) is loaded from side.



**T**HERE'S something for everyone in the new Renault R-8, which has just taken its place beside the Dauphine in the showrooms. For those who buy cars by engineering specs, the R-8 offers:

- Self-adjusting disk brakes on all four wheels.
- Combined transmission and differential (trans-axle).
- A closed-circuit cooling system, sealed at the factory, that never needs checking or winterizing.
- A crankshaft supported on five main bearings.
- Independent suspension on all four wheels.

For those who buy looks and comfort, the R-8 offers a pleasantly Americanized appearance with a fair-size trunk (eight cubic feet) and comfortable seating for four (bucket seats in front).

For those who buy handling, the R-8 offers exceptional road stability and a floor-mounted, four-speed shift.

With a rear-mounted 956-cc. engine that puts out 48 hp. at 5,200 r.p.m., the R-8 can do a standing quarter-mile in under 21 seconds, has a max speed of around 80 m.p.h., and should gallop well over 30 miles on a gallon of gas.

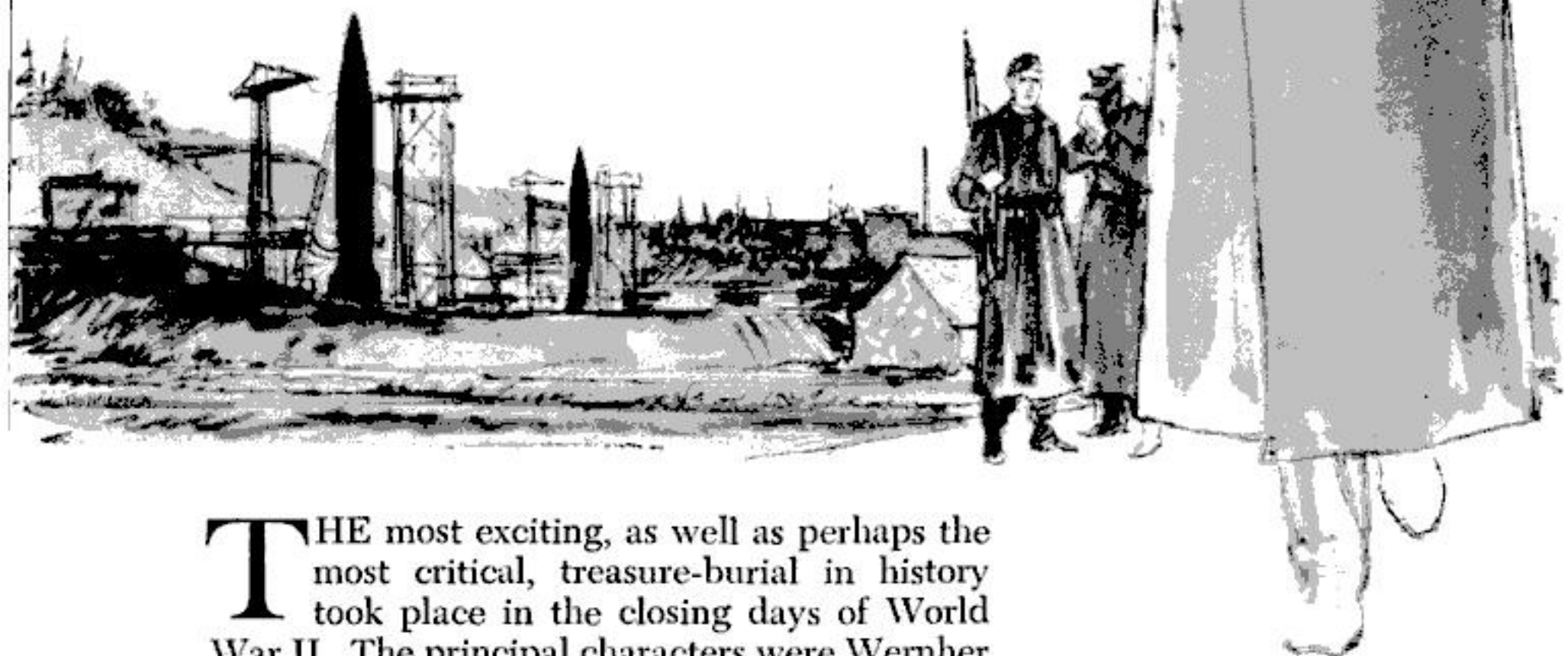
Renault, which has Volkswagen in its gun sights, now has the VW well bracketed. The Dauphine undersells it by a good margin, and the R-8, on the other side, goes for about \$1,800.—*Everett H. Ortner.*



How the German rocket experts saved  
their secrets for America

# History's Wildest Game of Hide-and-Seek

By Gardner Soule



**T**HE most exciting, as well as perhaps the most critical, treasure-burial in history took place in the closing days of World War II. The principal characters were Wernher von Braun, then Germany's top rocket expert, now head of America's George C. Marshall Space Flight Center, and his assistant, Dieter Huzel, now with the Rocketdyne Company.

As the Russians closed in from the east on Peenemünde, Germany's rocket center on an island in the Baltic, the Germans moved their key personnel—and their tons of records—south to Bleicherode. Then the U.S. Army approached from the west. Who would get the records and the scientists—the Russians or the Americans?

Fortunately, *we* did. Turn the page to see how, according to Huzel's eye-witness account, it all happened.

*From the book Peenemünde to Canaveral, by Dieter K. Huzel. Copyright 1962 by Prentice-Hall, Englewood Cliffs, N.J. \$4.95*

## Red threat from the east

1. On March 12, 1945, with the Russian army at Swinemünde, only 50 miles away, the world's greatest rocket base went into a frenzy of evacuation activity. By truck and railroad, men streamed south. With the rocketmen went their records—top-secret research results that, at the time, were unique in the world. The plan was to set up the base again at Bleicherode, southwest of Berlin. The Germans would not admit that the war was lost.

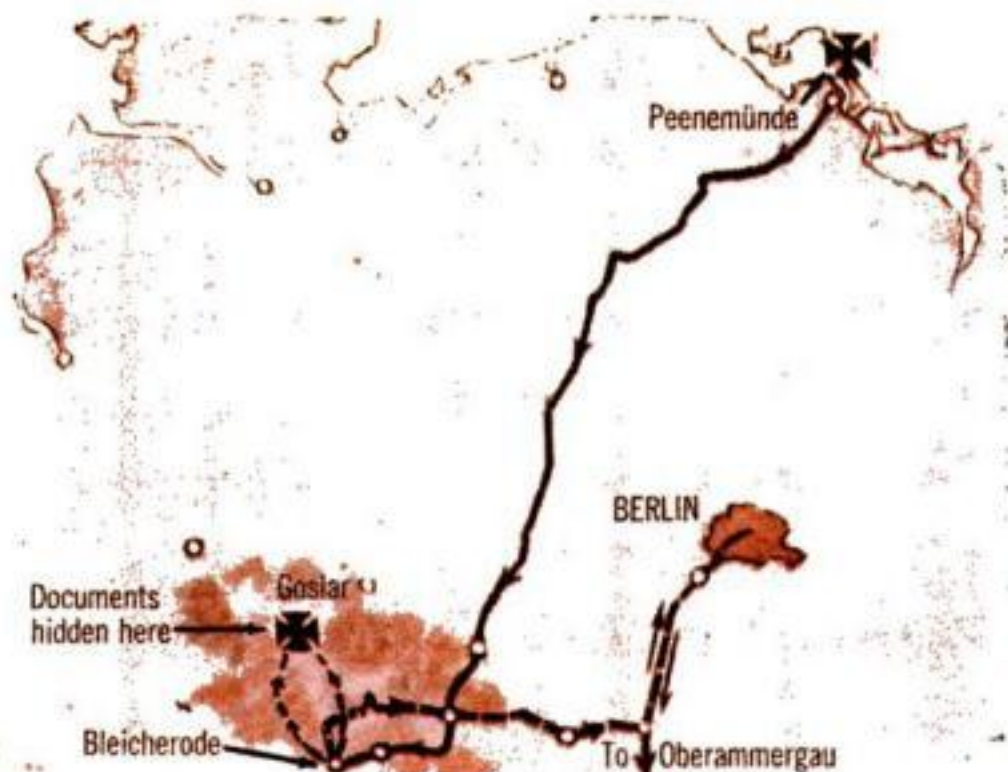
CONTINUED





### Ghost town in the moonlight

2. Dieter Huzel, an engineer who worked on all phases of the German rocket effort, was one of the last to leave Peenemünde. "I strolled down the street," he writes. "The moon, just past full, shimmered down between the rows of quiet, deserted buildings. There were a few traces of light . . . I thought how peaceful it was." Next morning Huzel went south by car. Trees along the highway had been chopped down so they could be pulled across the road.



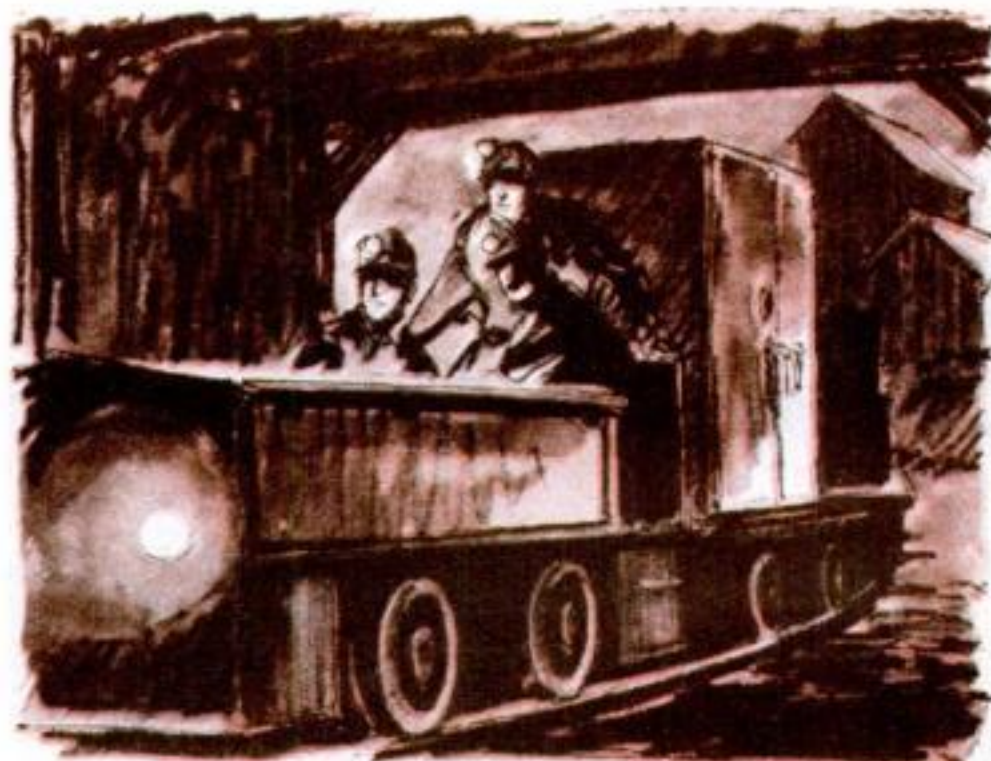
### U.S. tanks approach

3. Huzel reached Bleicherode by the route shown above. On Easter Sunday, word came that U.S. tanks had been spotted 12 miles away. The Germans began a frantic effort to hide some of the most valuable papers in history. Von Braun, his arm broken in an auto crash, turned the job over to Huzel. Handing his assistant a safe-conduct pass, von Braun said, "There is little I . . . can recommend to you on where to hide the documents. You're on your own."



### "Maybe there is something"

6. Desperate—hearing machine-gun fire now in the distance—Huzel raced his little car over twisting mountain roads toward Goslar. There the man in charge was uncooperative at first. Huzel exploded: "Here I stand, with the most important documents in Germany! And I can't even find a place to put them." The man reconsidered. "Wait a minute . . . maybe there is something." He guided Huzel to an abandoned mine—complete with a heavy, ironclad door.



### Found: a rock-hewn safe deposit

7. "It's ideal—it couldn't be better," said Huzel. Hurrying back to his trucks, he gave his orders: to drive to the mine one by one, during the night. All the men except the drivers were locked inside the trucks so they wouldn't know the location of the hiding place. Unloading at the mine, the men had a small electric locomotive and flatcars to help. Even then, the ton weight of the safe brought weary curses. The job took until the following noon.

**Special! Starting Next Month:**

**Dr. Wernher von Braun, world's leading rocket expert, will answer**





### The big blueprint move begins

4. Huzel commandeered ten men, three three-ton panel trucks, two trailers. Everyone was ordered to package the precious papers in small bundles. Huzel's men rushed about collecting the bundles—building up an astounding mountain of paper. With the trucks ready to go, it was found that one department (aft-end and rudder design) had its blueprints in small packages, all right, but locked in a huge, one-ton safe. The whole crew worked to get it loaded.



### Enemy planes appear

5. As the truck caravan hurtled along secondary roads, Allied fighters flashed by overhead. When a lookout on the fender of the lead truck shouted a warning, the trucks took cover under trees. Looking for an abandoned mine as a cache, Huzel drove ahead to Clausthal, in the German mining district. He found an old man apparently in charge and asked where he might hide his treasure. "I am very sorry," the old man told him. "Try our suboffice in Goslar."



### The paper treasure is buried

8. Next day, the mine gallery leading to the storeroom was dynamited, partially covering the big door leading to the hoard of rocket information. Events from then on, says Huzel, "assume a nightmare quality in my memory." Detouring back to Berlin by truck and bicycle, he reached the bombed-out city at one a.m. There he picked up his fiancée and fled south by truck. At Oberammergau, on the Austrian border, he caught up with Wernher von Braun.



### Happy ending—for the U.S.

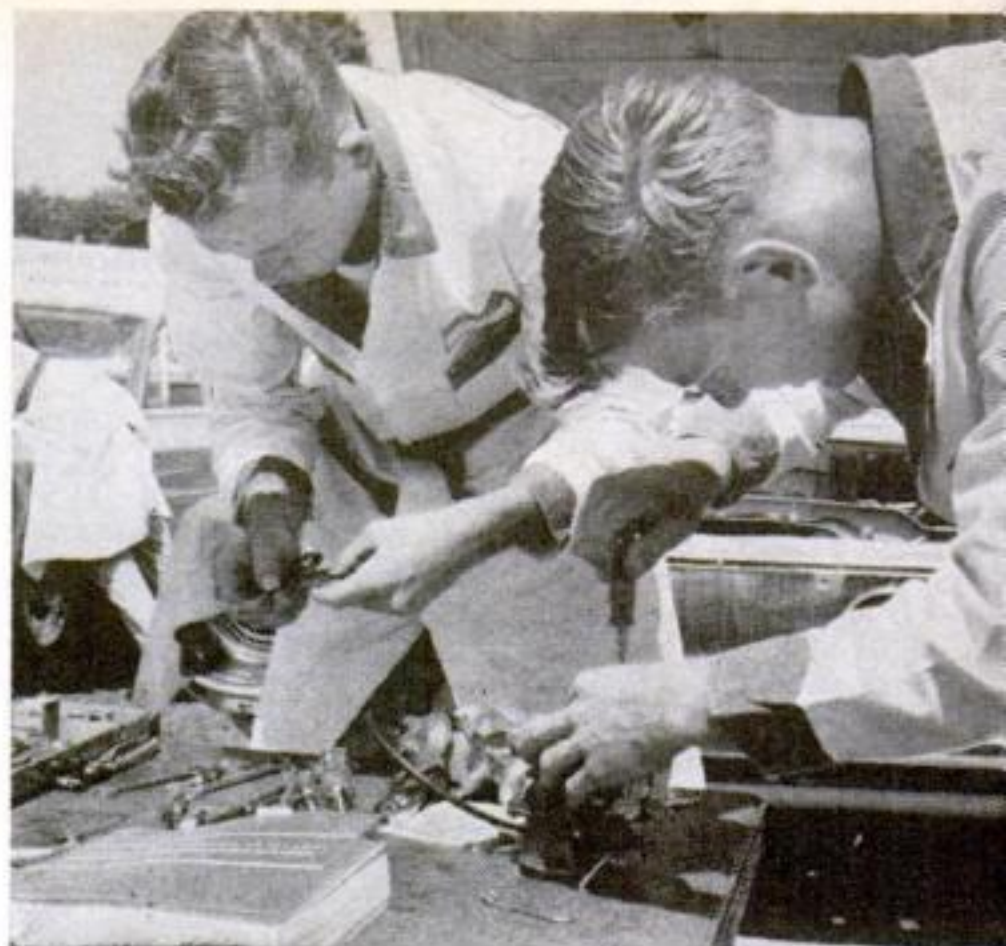
9. With the Russians pressing from the east, von Braun, Huzel, and five other German rocketmen drove to the U.S. lines and surrendered. Later, all were cleared to continue their work in the United States. Back at the mine, near Goslar, U.S. troops dug up the buried bonanza of rocket information. Thanks to von Braun, Huzel, and their men, who had moved west—not east—America, not Russia, would have the plans and blueprints of Peenemünde. ■ ■

**your questions about space--each month in Popular Science**



# Nobody Knows the Troubles They'll Find

Nobody knows but Plymouth. Everything's out-of-whack in its wacky "World Series" for young mechanics



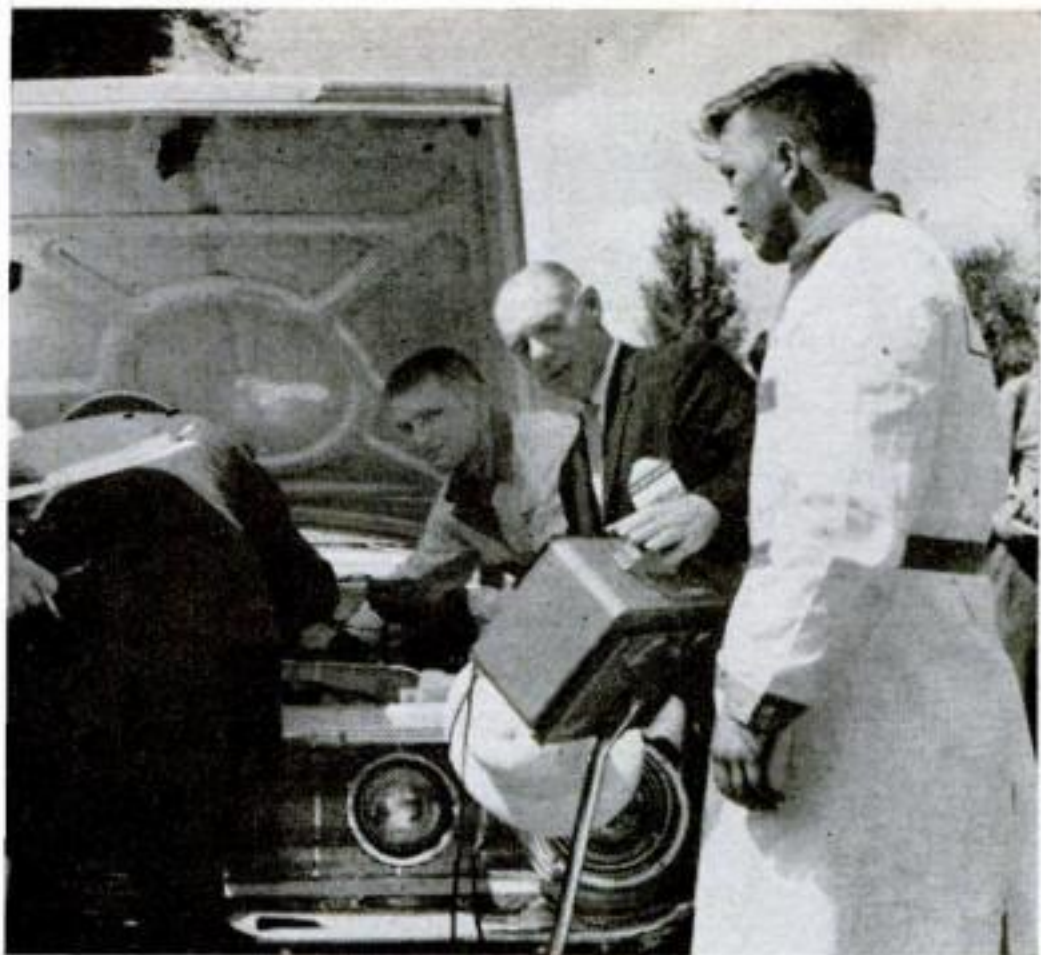
Carburetor is taken apart by Marv Huston and Dick Horbolt of Hiram Johnson High in Sacramento. Judges distributed spare parts.

By Alex Markovich

Metallic monster's victim? No, it's just a Depew (N.Y.) High student groping for an elusive spark plug. Ever get such accommodating action at your local service station?







Strain of long wait after crossing the finish line is apparent on contestants' faces as the judges check idle speed and spark timing.

**Y**OU twist the key nervously. The starter cranks without result. "Hold it," your buddy yells. He's examining the engine, his face wet with sweat. "No gas."

You jump out and follow the fuel line back to the pump. It has no arm. You yank it and slap in a replacement. You check the gas filter. Clogged. Another dash for a replacement. Better check the line from the filter to the carb while you're at it. You blow in one end. Plugged. Poking a wire through clears it.

A vandals' convention? Hardly. True, the brand-new Plymouth you're working on (alongside of 43 others) has been bugged. But the scene is the Detroit Fairgrounds, and you are in the finals of Plymouth's national trouble-shooting contest. You are—let's suppose—a young auto mechanic fresh out of a tough trade school. You were the sharpest kid in the class. And you've proved it by winning a regional car-fixing contest with your schoolmate buddy.

Now, though, the two of you are up against rough competition. Around you are 42 other teams from trade schools, junior colleges, and academic high schools from across the country. The stakes are high. First prize in each



The big moment: Bob Stupar (left) and Pat Gaffney of Bentley High get top trophy. The boys plan to take advantage of scholarships.

school category is two \$750 scholarships, a trophy, and a Plymouth engine for your school.

Back under the hood, you finally get the fuel lines cleared. But the ignition system is snafued, too. Two plugs, you find, have soldered points. High-tension wires are switched. The distributor is turned 180 degrees. You get to work.

Minutes later, your teammate cranks the engine again. It sputters and dies.

Should you risk precious minutes disassembling the carb? Your buddy's thinking the same thing. You glance at him. He nods. You grab a wrench.

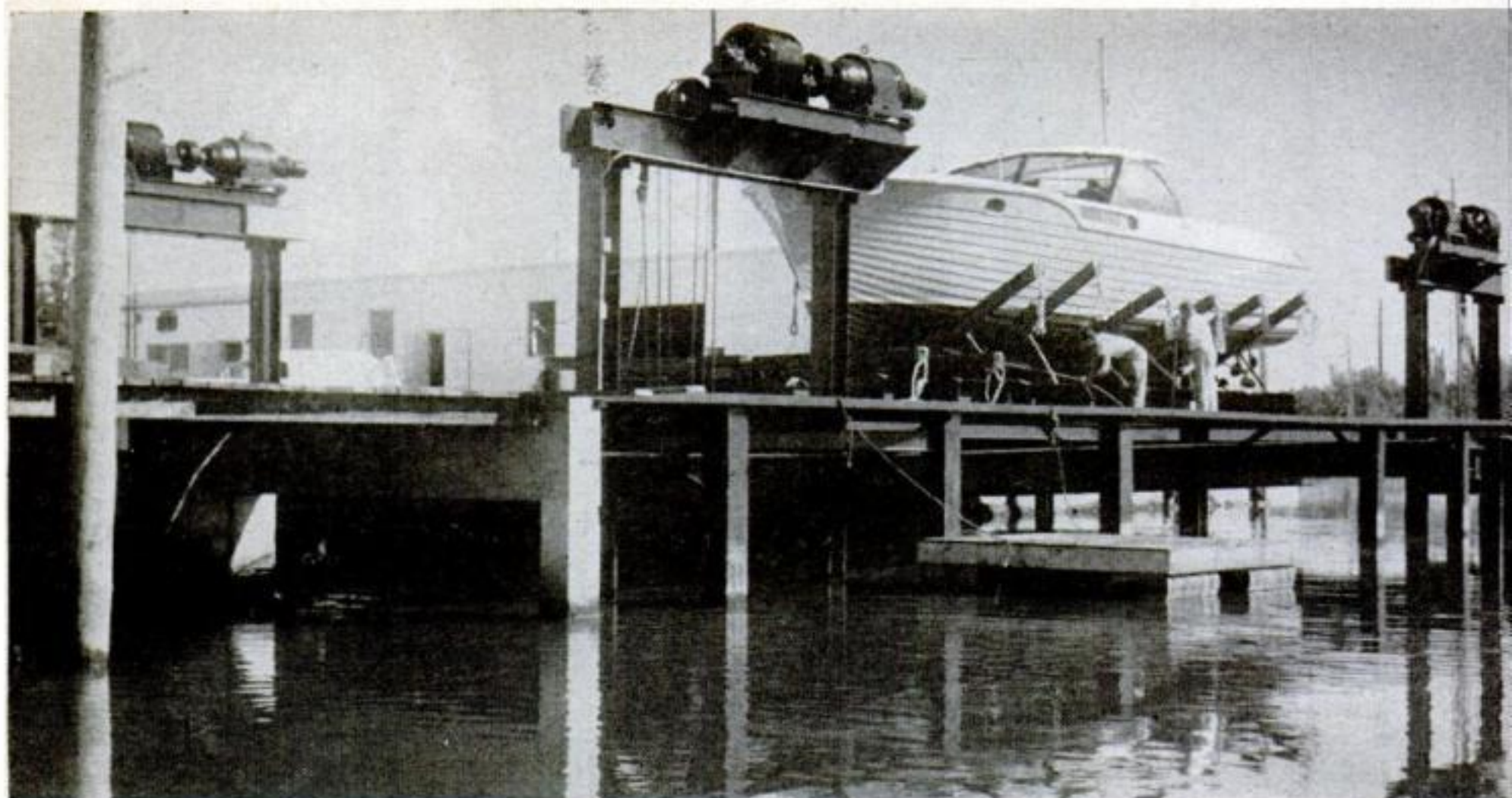
As soon as you take it apart you know you made the right decision. The idle tubes are defective. A gasket is cut. Float needles are plugged.

Finally everything is buttoned up again. Timing and idle speed are perfect. Now all that's left is to drive across the finish line.

If your name happens to be Pat Gaffney or Bob Stupar—industrial-arts students at Bentley High School in Livonia, Mich.—you're first to finish.

What about the boys who didn't end up in the money? They still have their regional prizes. And chances are each has at least one attractive job offer.





Motor hoists at corners lift cabin cruiser out of water on wood-decked, welded-steel platform.

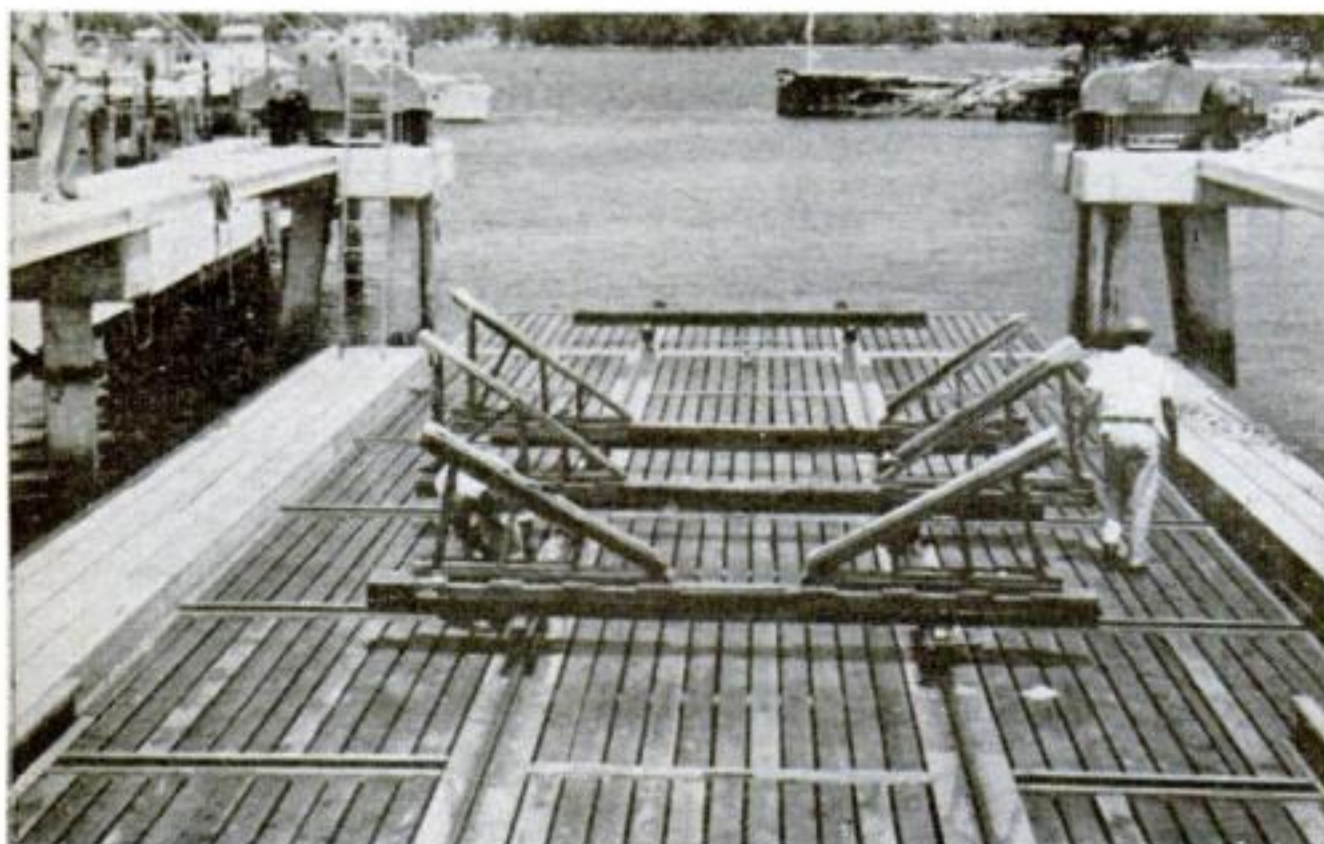
## Boatyard elevator speeds drydocking

Newest in equipment for putting boats into drydock for overhaul is this marine elevator—essentially a rigid steel platform with four synchronized motor hoists at the corners. Pushbutton-operated by one man, the three-hp. motors will lift the platform out of the water at an even speed of 1.5 feet a minute.

All a boatyard needs for installation of the automatic drydocking, called a Syncro-lift, is two piers to support the hoists or a slip cut into the land. Using four, eight, or

more hoisting units, it can drydock boats up to 8,000 tons. With a system of longitudinal or transverse rails, it can handle a number of boats at a time, lifting them out of the water one by one and transferring them to land.

The lift was developed by Raymond Pearlson, president of Pearlson Engineering Co., Miami, Fla. He has installed units in boatyards over the world. Those shown here are in the Bertram yard in Miami and the Spencer yard in West Palm Beach.



Tracks under cradle allow a boat to be pushed off the elevator for work ashore, leaving room for other boats to be picked up from the water. Each hoisting unit is equipped with reduction gears that multiply lifting power of the small motors, enabling them to handle really big boats. Automatic braking takes over in case of power failure.





## Superhauler for desert travel

Built for supplying the oil fields of the Spanish Sahara, this giant truck can haul 35 tons of drilling equipment at nearly 40 m.p.h. The six-wheel-drive Scammell tractor is powered by a 250-hp. supercharged diesel engine with eight-speed semiautomatic transmission. Support legs of the 38-foot semitrailer have detachable "elephant feet" to prevent its sinking into soft ground when the tractor is unhitched.



## Air sled smooths muddy track

A propeller-driven float (above) pushes rain water aside and smooths the surface of the race track at Saratoga Springs, N. Y. Taking a leaf from the air boats that skim over shallow water, the New York Racing Association tried out the sled, powered by an airplane pusher prop. Advantage over floats pulled by tractor is that the self-propelled one leaves no wheel marks.

## PS teach-yourself chase

**STARTS ON PAGE 60**

**K**

Your answer was:

If  $m$  is any integer, even or odd, the integer  $n = 2m + 1$  must be odd.

You are correct.  $2m$  is always even, so  $2m + 1$  must be odd.

Very well, the problem of showing that if  $n$  is odd ( $n^2 - 1$ ) is divisible by 8 reduces to showing that  $(2m + 1)^2 - 1$  is divisible by 8 whether  $m$  is even or odd, since we can write any odd number,  $n$ , in the form  $(2m + 1)$ .

There are no 8's showing in  $(2m + 1)^2 - 1$  at present. Let's square the quantity in parentheses, clean things up a bit, and see if that shows us where to go next. Which equation below is correct?

	BOX	PAGE
$(2m + 1)^2 - 1 = 4m^2 + 4m + 1$	T	176
$(2m + 1)^2 - 1 = 4m^2 + 4m$	X	180
I don't know how to square $(2m + 1)$ .	E	26

**L**

Your answer was:

If  $m$  is odd,  $m + 1$  is odd.

Come, come, now. If we have any odd number and add 1 to it we'll get an even number, won't we?

Now return to Box P, Page 170, and try again.



# "I'd like to see them make..."

Speed-the-mail boxes with a locked, removable container at side or back. A mailman would lift out a full drawer and replace it with an empty one.—*J. L. Peters, Brooklyn, N.Y.*



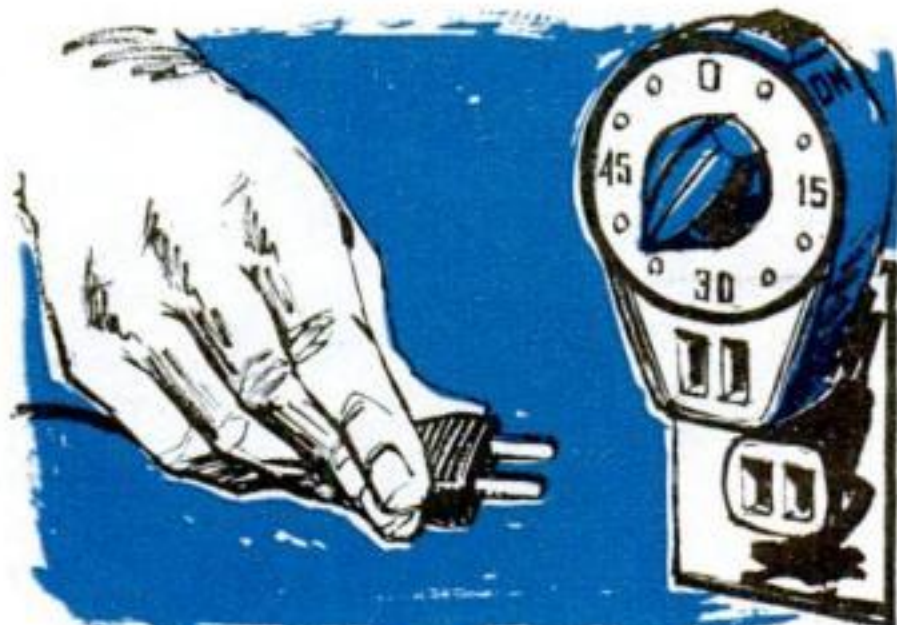
Illuminated saber saws. If there were a small lamp just above the blade, you wouldn't be constantly shifting the light source as you worked.—*Len Watson, Cincinnati, Ohio.*



Come-apart hinges on car-trunk lids so you could lift off the cover. They'd make it easier to carry large objects in the current crop of flat trunks.—*R. Archart, Gary, Ind.*



Wired Christmas trees of plastic with built-in light sockets to eliminate all those unsightly cords and the tedious job of stringing them.—*Thomas Zadlo, Trumbull, Conn.*

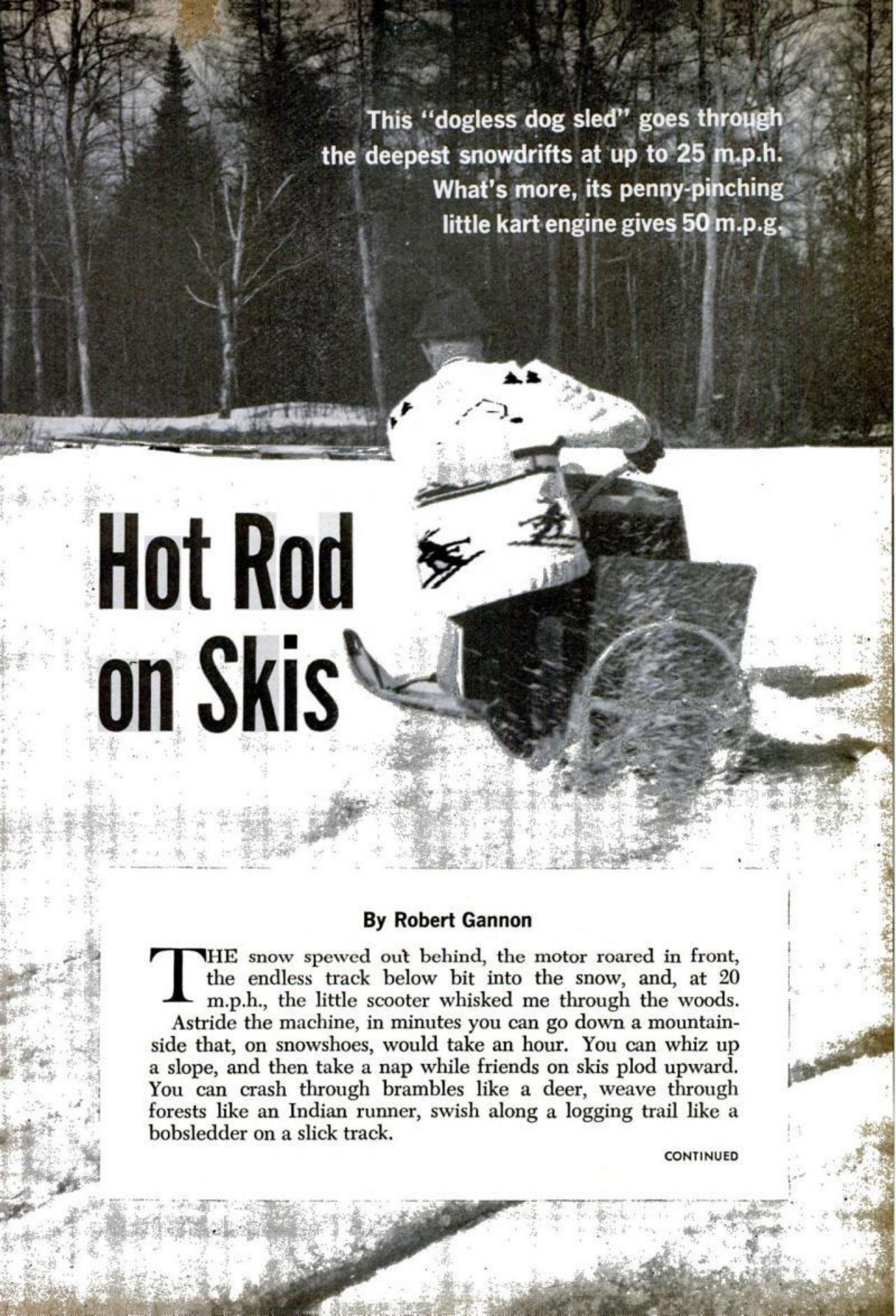


A plug-in time switch for sleepyheads. Wind it up, plug a radio or TV into it, and the set would go off after the preset interval.—*N. Robinson, Northbridge, Australia.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 17. Write your name and address clearly. Contributions cannot be acknowledged or returned.



A black and white photograph of a person wearing a white ski suit with dark patterns, riding a motorized sled through a snowy forest. The sled is a small, low-profile vehicle with a single large wheel at the back and a handlebar at the front. The rider is leaning forward, and the sled is kicking up a cloud of snow. The background consists of bare trees in a winter setting.

This "dogless dog sled" goes through the deepest snowdrifts at up to 25 m.p.h. What's more, its penny-pinching little kart engine gives 50 m.p.g.

# Hot Rod on Skis

By Robert Gannon

**T**HE snow spewed out behind, the motor roared in front, the endless track below bit into the snow, and, at 20 m.p.h., the little scooter whisked me through the woods.

Astride the machine, in minutes you can go down a mountain-side that, on snowshoes, would take an hour. You can whiz up a slope, and then take a nap while friends on skis plod upward. You can crash through brambles like a deer, weave through forests like an Indian runner, swish along a logging trail like a bobsledder on a slick track.

CONTINUED





*He climbs aboard, kneeling for better control . . .*

While the author snaps



*. . . and takes off with a roar, snow spraying behind . . .*

The machine is the Ski-Doo, a Canadian import just beginning to catch the imagination of Americans. This motorized toboggan is likely to be seen more and more around U.S. ski slopes, hunting lodges, farms—even suburbs.

Powered by a seven-hp. Kohler engine, the \$825 Ski-Doo looks like a fat motor scooter, and sounds like a healthy go-kart. You start it with a pull cord and steer the front-runner skis with a pair of motorcycle handlebars. The machine is propelled by a 15-inch-wide rubber belt with metal cleats that grip snow like a bulldozer tread.

Ski-Doo is manufactured by Bombardier Snowmobile, Ltd., of Valcourt, Quebec, an outfit that also makes four-ton log-hauling snow tractors. President J. A. Bombardier first got the Ski-Doo idea while plodding through the Canadian wilderness on snowshoes. Ridiculous, thought he; snowshoeing is a great sport, but physically punishing, and a top speed of a mile an hour is slow going indeed.

**Back at the shop.** Using some of the know-how developed for his massive snow tractors, Bombardier and his designers came up with a combination toboggan, sled, and skis. On tests, it carried two men and a barrel of molasses (pulled on runners) easily over snow or ice.

First use for the scooter was for toting

telephone linemen to winter work sites. Then the Eskimos latched onto the sled, found it was the best thing to hit the Frozen North since stripped blubber.

For one thing, the Ski-Doo hits 25 m.p.h. or more where a dog team of six is lucky to mush along at three. It can do 50 miles to a gallon of gas while carrying a 300-pound load; a dog team devours some 16 pounds of food a day. Those adept at figuring such things estimate that travel by dog sled costs 85 cents a mile, or more than a taxi.

Today some 3,500 Ski-Doos (about 600 in the U.S.)—from the Arctic Circle to New Mexico—are being used for everything from rescue work (some winter resorts keep fleets on hand for retrieving cracked-up skiers) to racing. Last winter, for an anniversary celebration, the mayors of Cochrane and Timmins, Ontario, raced 70 miles between the two towns in nearly 50-below weather.

My introduction to the little snowmobile came with a visit to Elliott & Hutchins, Inc., Malone, N.Y., distributor of Ski-Doos for the Northeastern states. At the shop, partner Duke Elliott and I lifted one 260-pound machine (with the windshield removed) into the back of a station wagon. With the skis off, its 72-by-30-inch body can fit into a car trunk, with the lid up. A second Ski-Doo was



photos, Ski-Doo distributor Elliott gives the machine a workout



*... swishes up a 32-percent grade and ski-jumps a knoll ...*



*... crashes wetly through a powdery snowdrift ...*



*... and banks sharply, using body English for balance.*

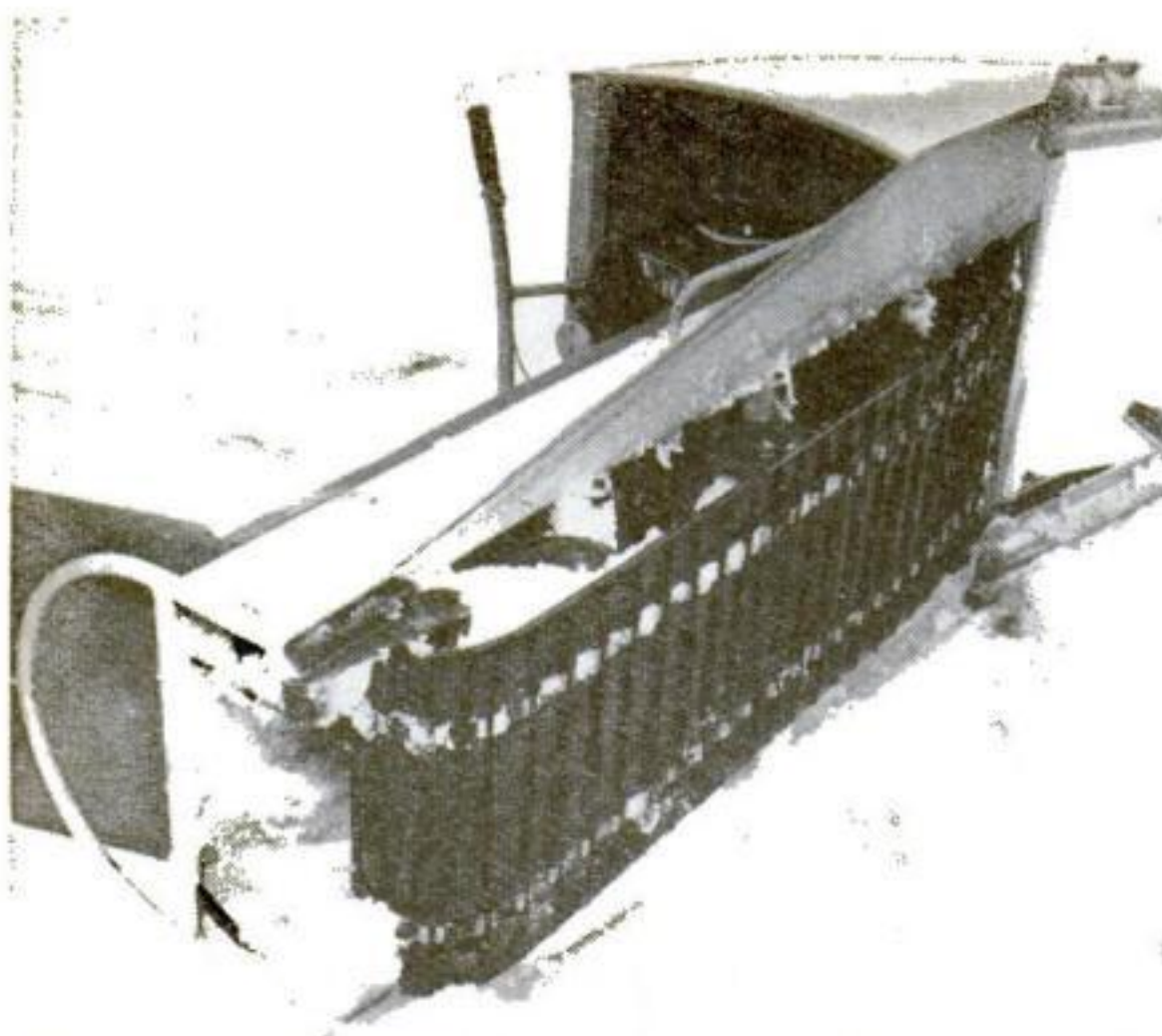


**Centrifugal belt transmission** is used with Kohler K161 seven-hp. four-cycle engine. (Eight-hp. engine is optional.) Roller-chain drive at left

runs in an oil bath and leads to sprocket wheels. To go, you squeeze the throttle on the right handlebar. To stop, let go. No brakes needed.

CONTINUED





Fifteen-inch-wide track rides on 10 sprung wheels and is driven by two more sprocketed ones. Skis are for steering.

driven onto a converted boat trailer and hooked on.

Our objective: an isolated hunting lodge in New York's Adirondacks, smack center in 18,000 acres of the wildest woodland I've ever seen. Each of the half-dozen businessmen in the Furnace Mountain Hunt Club has his own Ski-Doo to get to the lodge in winter.

At road's end, we unloaded our gas-powered dog sleds. With two starter-cord yanks, Duke had them going.

"Hop on and take over," he said.

"But I've never driven one."

"Makes no difference."

I slid onto the cushion—big enough for two to sit tandem—and gave her the once-over. The controls are the steering bar and a hand accelerator. That's all.

I took a breath and squeezed the throttle hard. The endless belt paddle-wheeled below me; I lunged forward off the road, up a steep 10-foot drift, and turned clumsily across the front of it. Off-balanced by the tilt, I fell flat on my face in the snow. The machine put-putted contentedly—came to rest a dozen feet ahead.

"Gotta have speed for bobsledding," said Duke, churning alongside. "Bank into it. Practice a bit."

Back on the machine again (and pooped from getting to it through the five-foot snow), I quickly learned the trick: a matter of body English.

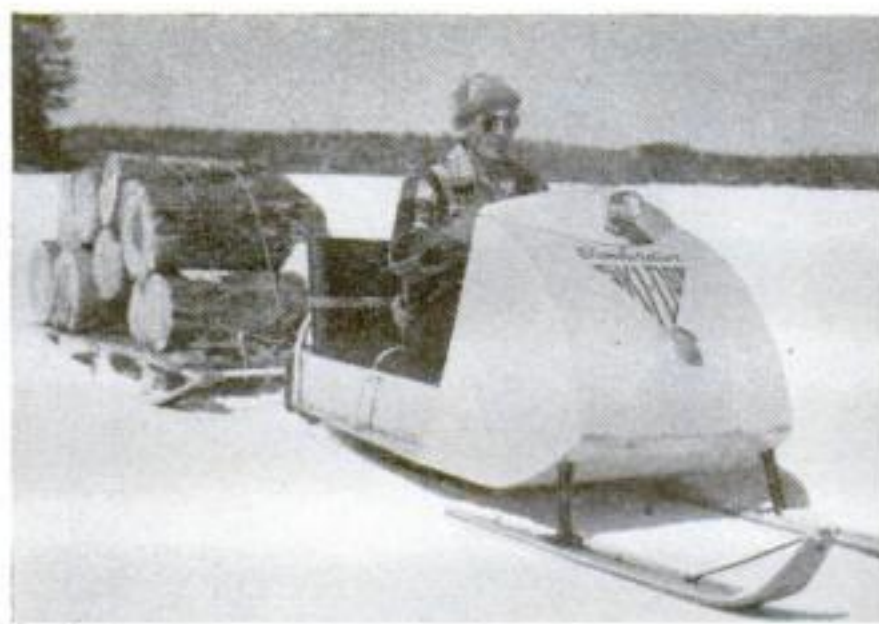
**Driving is simplicity itself.** Shifting is automatic; a centrifugal transmission selects the right ratio. To stop, you merely release the throttle; the engine idles and the transmission disengages.

When you get the hang of Ski-Dooing (in, say, five minutes) you get kind of wild. You spot a hill and bank off the side

*[Continued on page 180]*



Traveling over mud, Ski-Doo is slower and rougher, but makes it nicely. One tankful of gas lasts for about 10 hours of cruising.



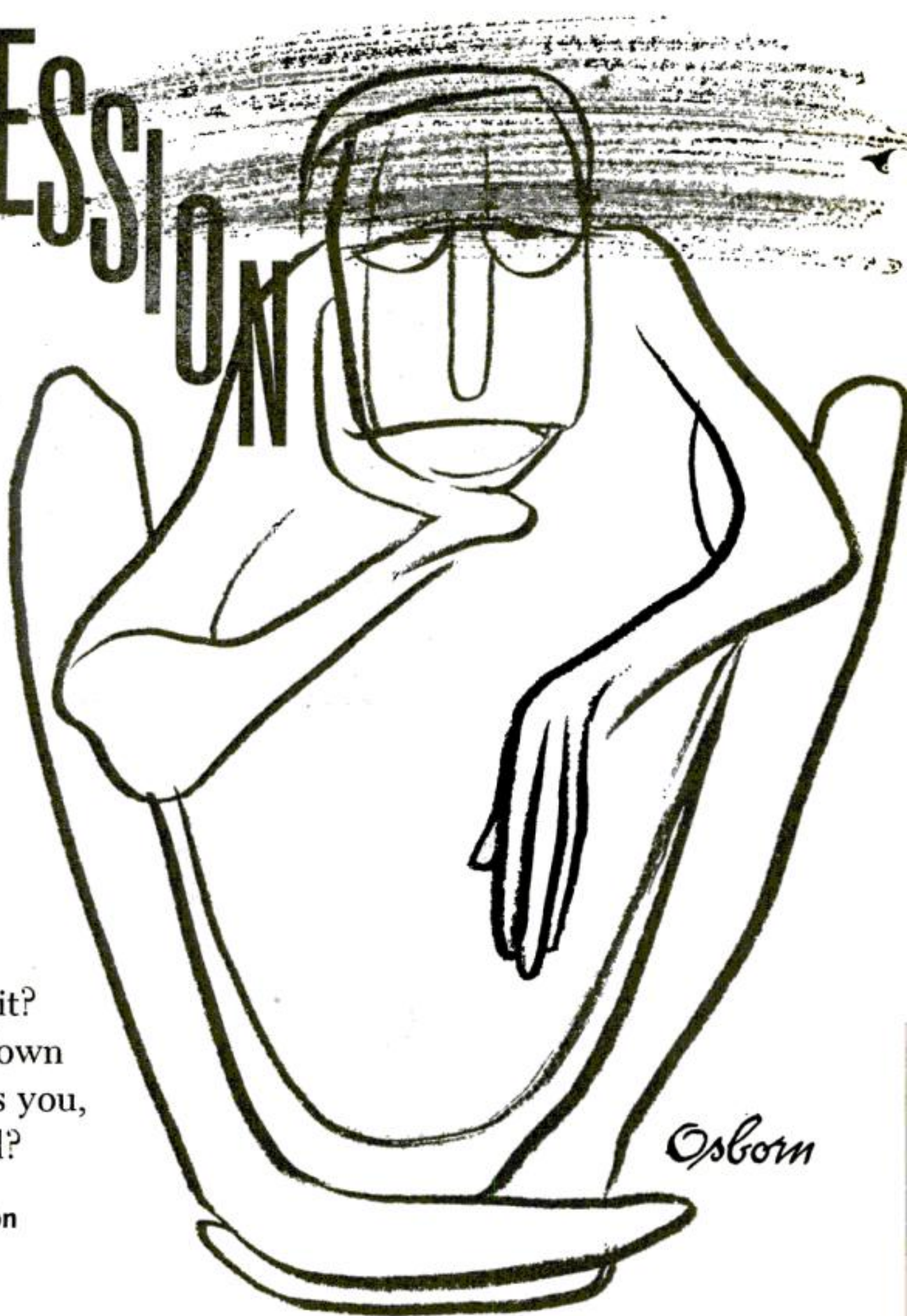
Hauling wood across frozen Saganaga Lake on Minnesota-Ontario border is one of the jobs the vehicle performs for trapper Irvin Benson.



# DEPRESSION

What causes you to feel "down in the dumps" and how serious is it? If real, deep-down depression hits you, can it be cured?

By Lawrence Galton



**M**OST of the time you feel "up," occasionally "down." That's par. There's nothing unusual about a brief spell of the "blues" now and then.

But ask medical scientists today what the most common of all health problems may be and they'll point to depression—a general name for a vari-

ety of "blues" that are real sicknesses.

They can turn up disguised as everything from crushing fatigue or crashing headaches to false heart trouble or belly pains. You yourself may not be a victim, but chances are you know somebody who is—perhaps someone in your family.

Once recognized, depression can be

CONTINUED



## Depressed people blame their condition on sickness. Not so,

alleviated. Yet some authorities estimate that for every case uncovered, five others may go undiagnosed.

*What are the general symptoms?*

Depression is characterized by a lowering of spirits and vitality.

There's a chronic change of mood. You feel distinctly or vaguely sad. You slow down mentally, find it tough to work, or have to push twice as hard to get the same things done.

Chances are the depression may focus on the body, giving you something physical to worry about. "Nothing," one authority says flatly, "in the human organism remains the same from inception until termination of this illness." Commonly, depressed people are more bothered by their body symptoms than by their blue feelings. They blame their mood on physical troubles, instead of vice versa.

*What are the different kinds of depression?*

At the extreme there are people who are manic-depressives. They swing back and forth in cycles between profound depression and great happiness. When exuberant, they're often full of grandiose schemes and delusions of grandeur. But when depressed—usually the more predominant state in this serious mental illness—they're overwhelmed by feelings of guilt and worthlessness.

Then there is the "involutional melancholia" that strikes some women after the menopause. It can also affect men in the 45-to-65 age bracket. This form of depression produces overwhelming despondency, delusions of sin and unworthiness, outright hallucinations. Some experts think it's the result of changes in the hormone balance caused by aging. Others say it may not be a matter of hormones at all—rather, a reaction to growing old.

But by far the most common kinds of depression are "mild" depressions. These are definite emotional disorders but, be-

cause there's no psychosis, no living in another world, they are harder to detect.

*Are some people more apt to suffer than others?*

Maybe. Some authorities think that mild depressions turn up more often in people who are worry warts, perfectionists, and hypersensitives. But they can turn up in others, too, no matter what their occupation, financial status, or social position may be. Nor are children exempt.

*What triggers a depression?*

Sometimes an unhappy experience—death of a loved one, loss of a job, failure of a promotion to come through. Such a depression is called "exogenous," meaning it comes from outside.

But there's another sort of mild depression that develops without any apparent cause. A man may suddenly decide he's a failure when he isn't. Or the daily stresses and strains of living—social problems, economic problems, family problems—once taken in stride, suddenly become overwhelming.

Depressions like these are called "endogenous," meaning that they come from within, perhaps because of a chemical derangement in the body.

Actually, some physicians report that a mild depression is frequently mixed—both endogenous and exogenous. Others maintain that there *must* be an endogenous factor—otherwise stress and strain would produce only some normal dejection.

*What's the most common symptom?*

Fatigue, say investigators at Massachusetts General Hospital after a four-year study of depressed patients. At the same time the victim often has difficulty falling asleep. Others may get to sleep all right but then wake early in the morning and toss for hours. In fact a sudden tendency to wake up very early is often a cardinal sign of depression.



## say researchers. Depression probably caused the sickness

### *Is sexual function impaired?*

Generally there's a decrease in sexual vigor. And partial impotence often develops.

In some men the depression produces urinary symptoms—frequency, burning, pressure in the bladder area—which lead to anxiety. The anxiety then intensifies the urinary symptoms, which in turn further impair sexual function.

In some women, there are complicating menstrual changes, and these may be attributed wrongly to gynecological disorders. Often, says Dr. Frank J. Ayd, a distinguished authority on depression, hysterectomies or other pelvic operations may be performed needlessly.

### *What other physical symptoms stem from mild depression?*

An almost endless variety. Some people suffer from one or two; some, from many. Here's just a partial list:

Loss of appetite; headaches; pressure on top of the head or in the temples; pulling sensations in back of the neck; noises in the ears; dizziness; visual disturbances; palpitations; difficulty in breathing; constricting sensations in the chest (some depressed patients worry about "heart trouble"); constipation and other digestive disturbances.

One example of the coupling of physical symptoms: A young and husky engineer suddenly lost his appetite and, in three weeks, lost 20 pounds. He also developed splitting headaches and chest pains. There was no physical cause. An alert physician found he'd had several similar but less severe episodes in the past. Always they came when pressure on the job grew intense. At such times, the engineer admitted, he felt discouraged, dejected.

### *Does depression lead to alcoholism?*

Sometimes, but more often depressed people drink excessively only when under depression. They're what some doctors call "periodic alcohol addicts."

### *Can mild depression complicate other illness?*

Yes. Johns Hopkins investigators, in the summer before an Asian flu outbreak, gave psychological tests to 600 employees. That winter, many got flu. A check revealed that those shown in the tests to have depressed natures needed three weeks or more to recover from flu; the others were well in 3 to 14 days.

### *What about actually bringing on physical ailments?*

University of Rochester researchers made a study of 42 hospital patients—businessmen, laborers, housewives, teachers. Ages ranged from 18 to 45; ailments, from bronchitis to brain tumors.

They found an extraordinarily high number—39 out of 42—had had a depressive blow not long before the onset of the illness—often just hours before.

For example, a 31-year-old salesman, tried to keep his wife from going back to work after she had recovered from an ulcer. For one thing, he feared she might have a relapse. But her going back also depressed him because it indicated that his own financial provision was inadequate. Eight hours after she returned to the job he came down with infectious mononucleosis.

Says Dr. Edward J. Koffar of the University of California School of Medicine: "During five years experience as chief of a large general hospital, I gradually became aware of the large number of patients who had masked depression, sometimes behind a smiling, amiable facade. I agree, of course, that anyone who is ill is entitled to react to his illness with depression. The point I wish to emphasize is that these individuals were depressed before they developed the illness."

### *How long do depressions last?*

Most begin almost imperceptibly and follow a gradual downhill course. The average duration of an untreated attack



is nine months. That's an overall figure. In childhood and adolescence the period may be far shorter; in old age longer. Generally, attacks recur.

### ***Do depressed people deny they're depressed?***

Yes, often. They also shut off their feelings. "You'd be depressed too," they say, with misplaced conviction, "if you felt [physically] the way I do."

One study of the records of 500 depressed patients showed that 74 percent first consulted a physician because of headaches, chest pains, and the like. About half were aware they had experienced a distinct mood change, but they believed this was the *result*, not the cause, of their body symptoms. In some cases useless surgery is carried out before the depression is diagnosed.

### ***What can be done to "cure" mild depression?***

Shock treatment—a series of short, sharp bursts of electric current—was once thought to be the most efficient method. The results often are dramatic, especially when there is danger of suicide. In the case of involutional melancholia about 80 percent of patients respond. And shock often helps other severe cases, including manic-depressives.

Compounds such as insulin can also induce shock. They produce convulsions, coma—and often—dramatic relief.

### ***What about drugs?***

These are by far the most popular method of treating depressions today, especially in mild cases. Amphetamines, such as Benzedrine, stimulate the nervous system and elevate mood. But they also elevate blood pressure and may cause insomnia and nervousness.

A newer class of drugs—the "psychic energizers"—has come into use in the last three or four years. A group of these known as monoamine oxidase inhibitors appears to have a specific antidepressant action.

It's believed that chemical substances in the brain called monoamines stimu-

late nervous activity. Normally, these monoamines are destroyed by an enzyme called monoamine oxidase (MAO) so they won't pile up. It may be that in depression there's too much MAO, too little monoamines. The psychic energizers curb MAO actions, thus making monoamines more available to stimulate the brain.

Striking improvement with the psychic energizers even in some of the very severely depressed has been noted. The medical report on one 24-year-old man reads: "He states that prior to treatment he felt like 60 and now feels like 15. He commented that not only does he no longer become depressed but says, 'I don't want to get depressed any more—and can't even when I try.'"

But drugs do not produce overnight effects. Very frequently a week or two must elapse before there is any noticeable improvement. And treatment in many cases must continue for at least three months to assure continuing benefits without relapse.

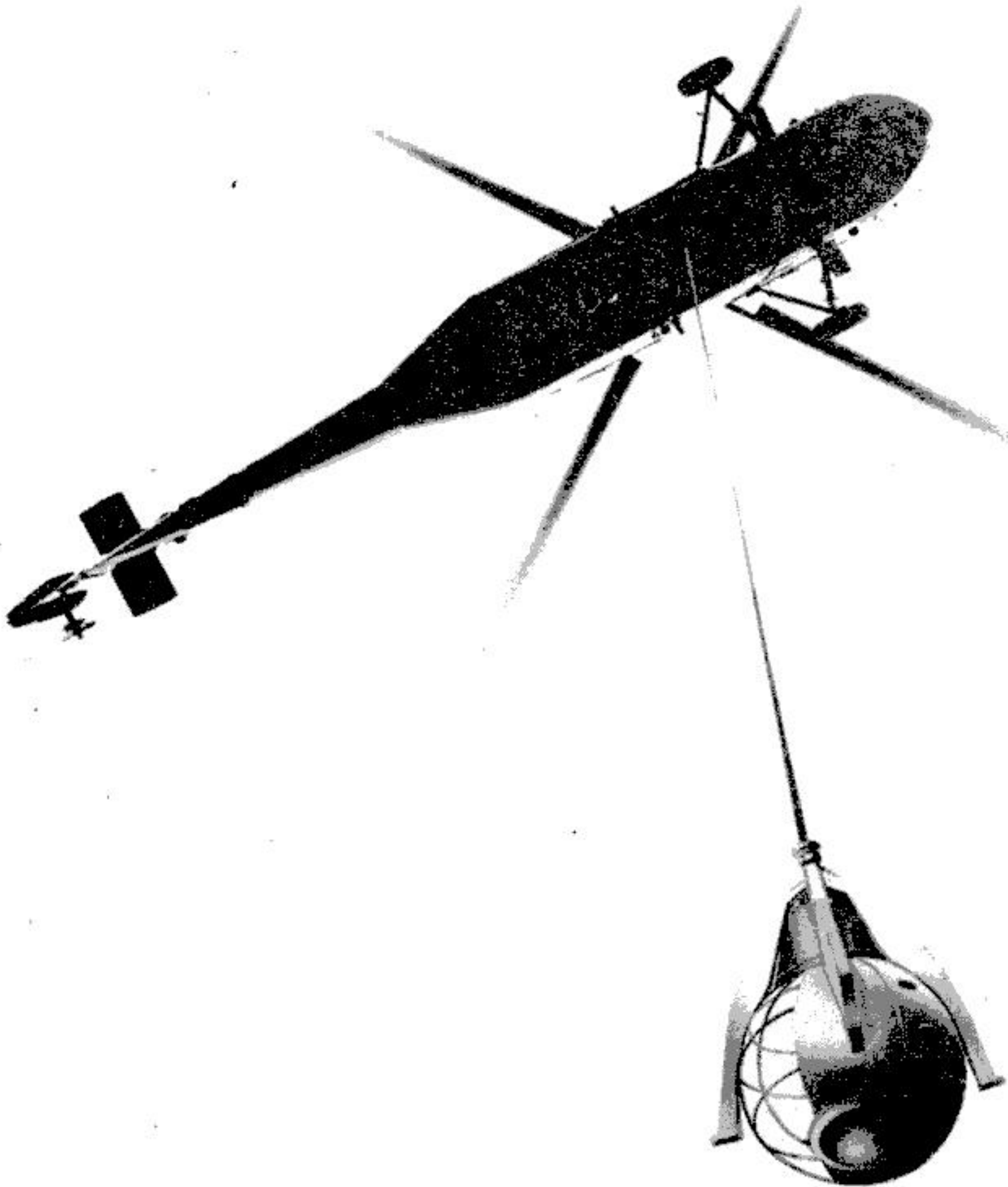
### ***What should you do if you think you, or your wife, or a friend is suffering a mild depression—not just a sour day?***

Go see a doctor—or encourage your wife or friend to do so. Also, if you or they seek medical help for some physical trouble, it's vital to mention any gloomy feelings to the doctor. That could pinpoint the real problem. If fatigue, for instance, is the result of depression, treating the depression will stop the fatigue while vitamins will not.

One important mistake to avoid: Don't tell a depressed person "You can get well if you want to." He already suffers exaggerated guilt—such advice may make him feel more unworthy and depressed.

Give comforting news. If the depression is real, and not just a temporary case of blues, there's a better chance now than ever that medicine can get rid of it, save endless weeks and months of mental anguish, and relieve any physical complaints brought on by depression. ■ ■





## Submarine's-eye view of new mystery weapon

The odd device dangling from this Wessex 1 helicopter is Britain's latest weapon for protecting the Isles and British shipping against submarine warfare. What is it? Detection equipment and a wonder weapon, is all the British Admiralty will say. Does it remain slung from the copter or is it

planted in the sea like a mine? The answer is "classified." But there's no secret about the Wessex 1. The advanced antisubmarine aircraft, powered by a Napier Gazelle gas turbine, has been on sea duty in the Royal Navy, will soon also be used in the Royal Australian Navy.



# Those God-Almighty Mallets!

Here's a farewell salute to the iron monsters that, for half a century, cut the mountains down to size

By Henry B. Comstock with sketches by the author

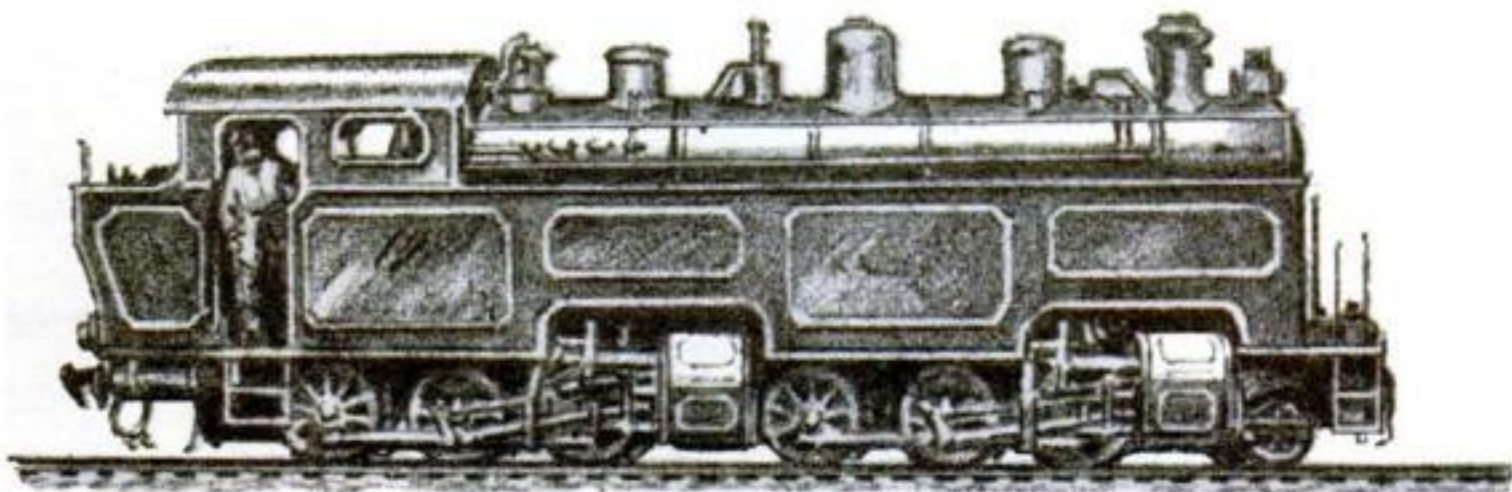
THEY lumbered over the rails with the grace of TV wrestlers doing the twist. They shouted through their stacks with a speech impediment. They had the mechanical finesse of a pile driver and the thermal efficiency of a Brownie campfire.

Yet for 50 years they were the world's biggest, guttiest, and most wonderful locomotives. Many could start a train so long the engineer and fireman traveled 200 feet before the caboose began to roll. You figure it out—there's 12 inches of slack between two coupled freight cars.

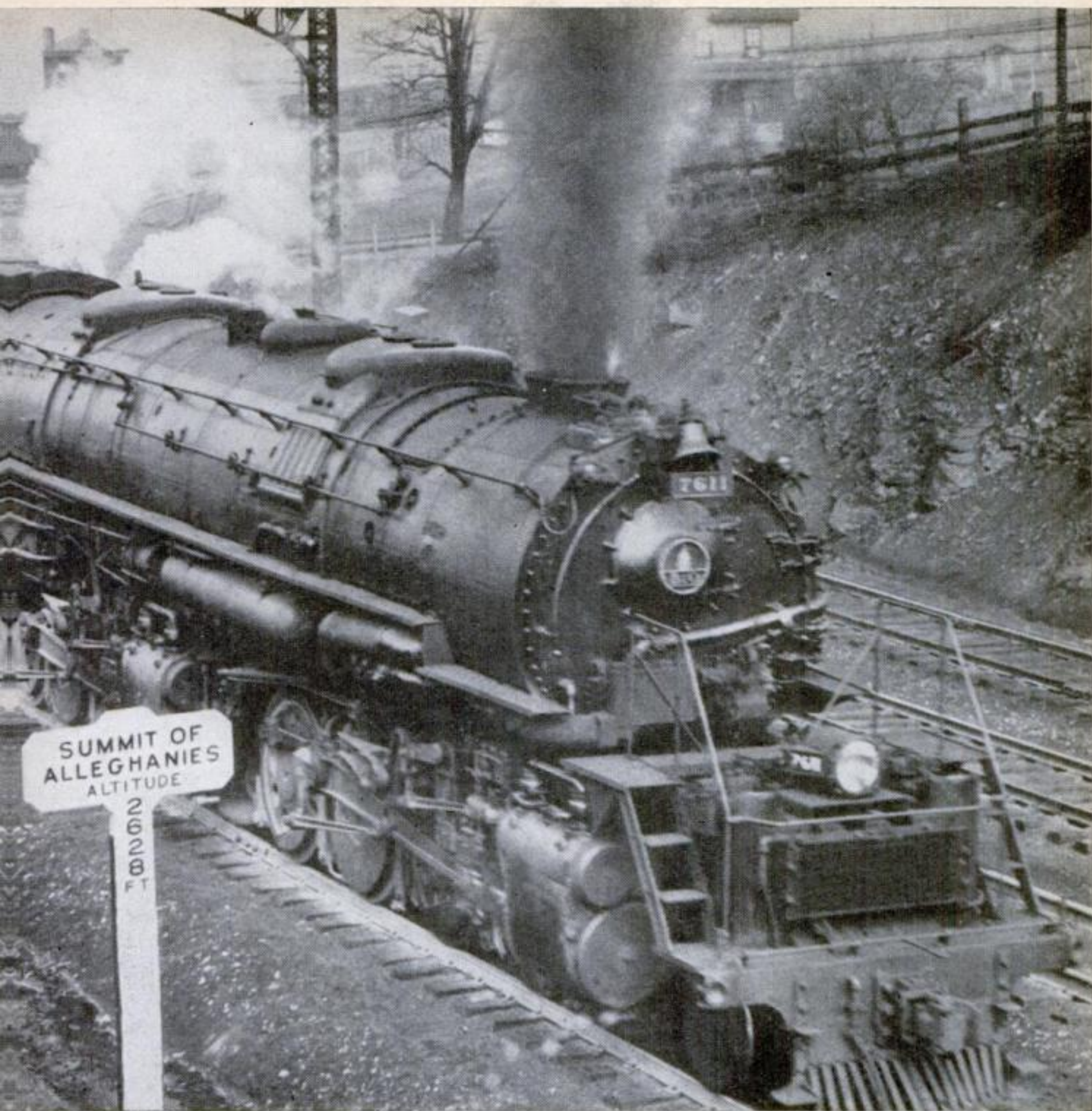
The railroad crews who tooted these monsters across the Appalachians, Rockies, and Sierras called them Mallets. So did three generations of small fry who could tell, without looking, whenever one of the



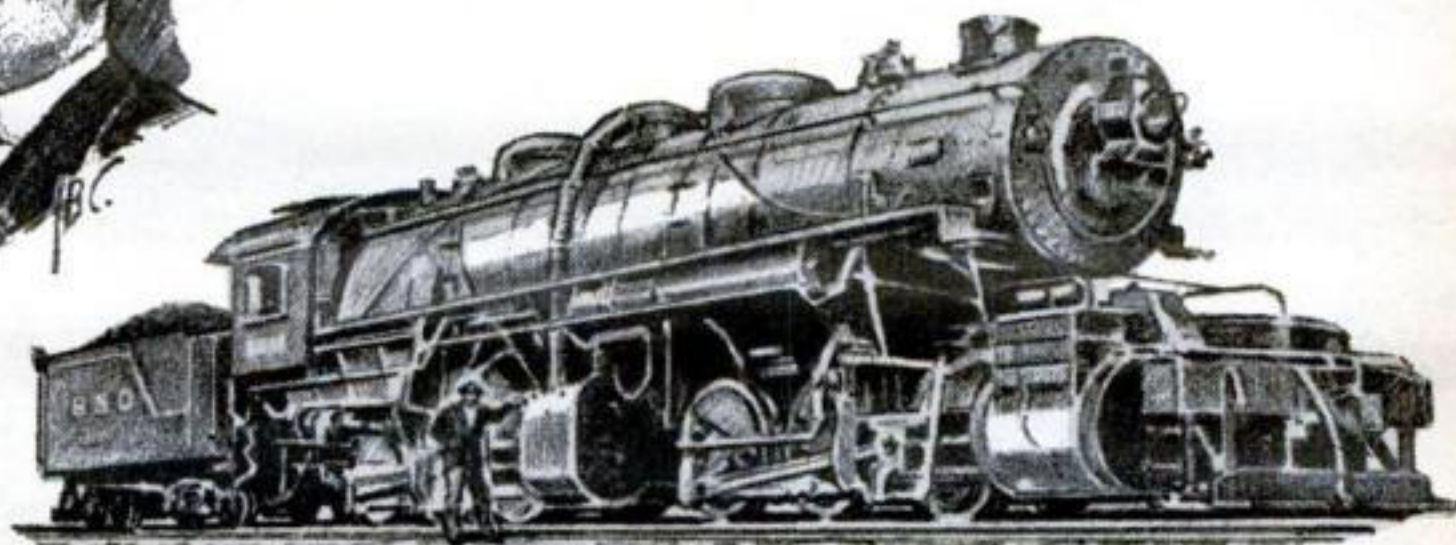
Scholarly Anatole Mallet (left) watched the first locomotive bearing his name labor over France's Bayonne & Biarritz Railway. "It is as I predicted," he said. "Each time one engine unit slips, the other bravely increases its power."



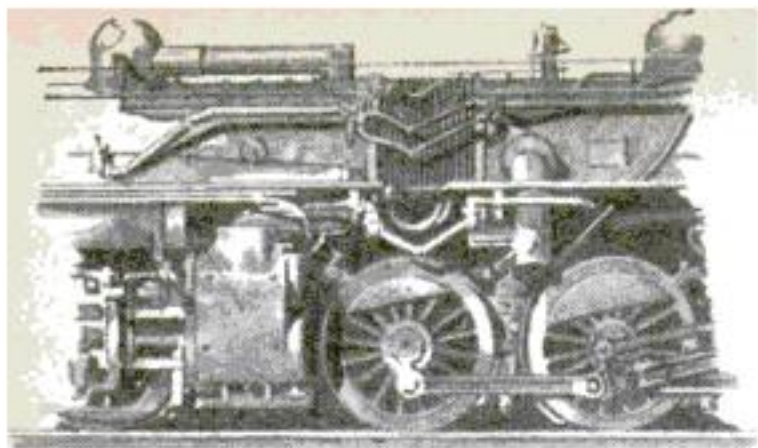




Mallets never won beauty contests, but few hinged locomotives could match the clean, uncluttered lines of the B&O monster above. She and 29 of her sisters were a far cry from "Old Maud" America's first Mallet (below), sponsored by B&O president, Leonor F. Loree, and designed by James Muhlfeld.

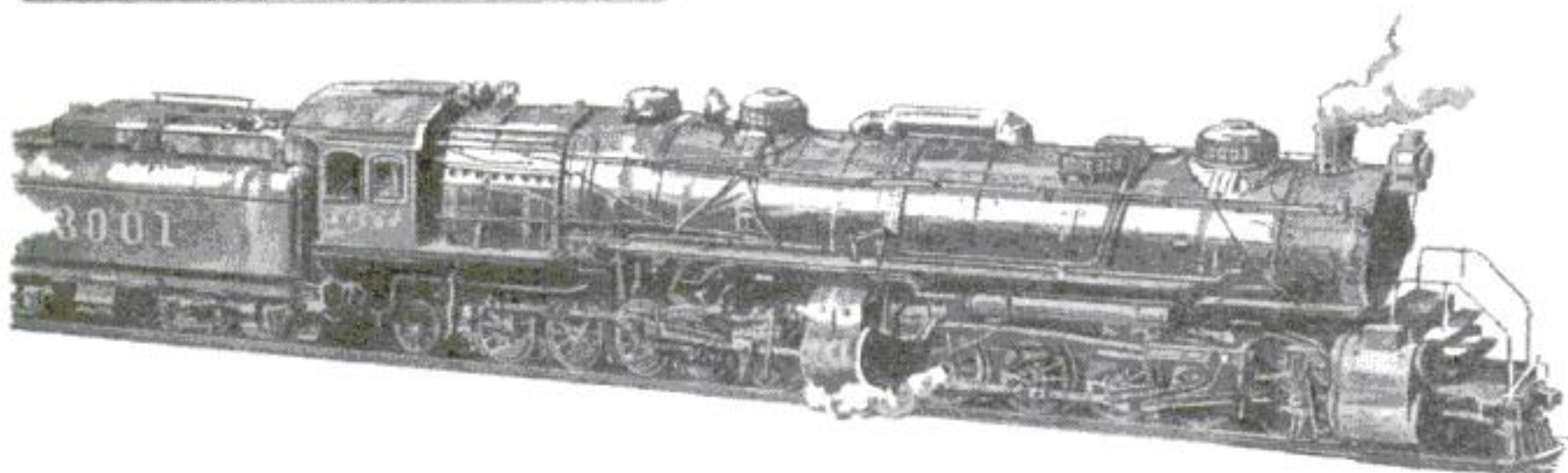






## No steam hog as grand and gutty will

**Weirdies on the Santa Fe** included 1910 Mallet with accordion-pleated midriff (left) to let boiler hinge with driving units under it. Long-barreled behemoth below was whipped up from odds and ends of two conventional locomotives.



giants was bucking a grade. The tipoff was the tumbling exhaust of four rarely synchronized cylinders.

That explained the Mallets' brute power. Each was literally two steam engines hinged, heel-to-toe, under one huge boiler. It was a setup that doubled the tonnage a single crew could coax over winding mountain rails.

The last and largest of the breed, Union Pacific's Big Boys—38-wheeled centipedes that stretched 133 feet and weighed 600 tons—retired this year. Anyone who ever watched them labor up Utah's Echo Canyon, blasting 10-story-high exclamation points from twin stacks, knows they put the right ending on the lustiest chapter in steam railroading.

**Engine with a Gallic accent.** The chapter began 90 years ago, when a bravely

mustached Frenchman came to the directors of the Creusot Locomotive Works. "I am Anatole Mallet, Publications Editor of the Academy of Science," he said. "I have come to show you my plans for an engine so small, flexible, and economical in relation to its tenacity that it will revolutionize mountain railroading."

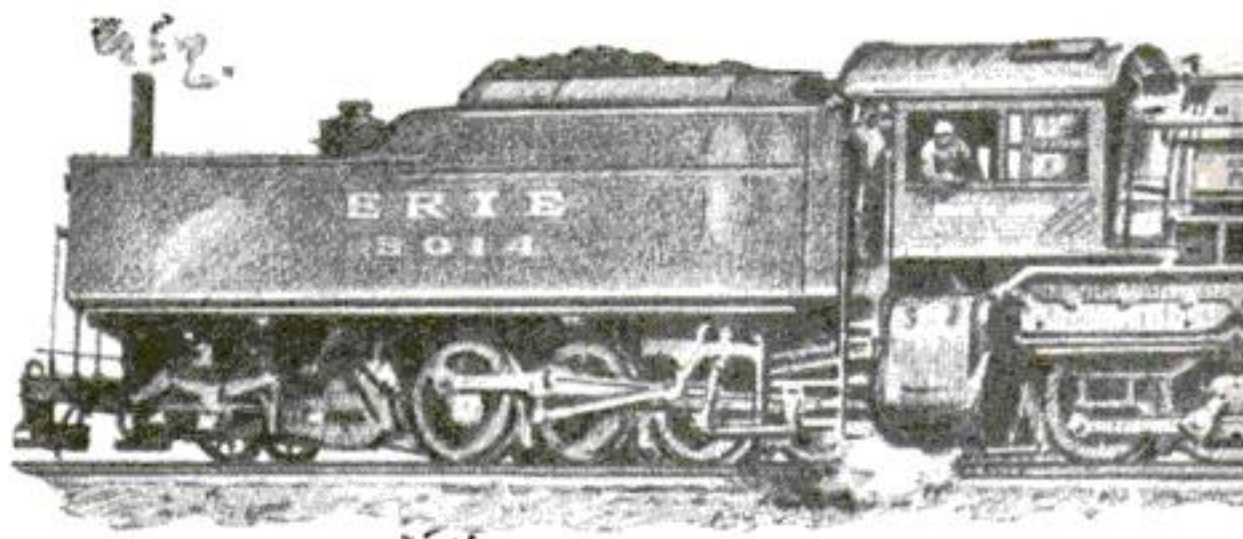
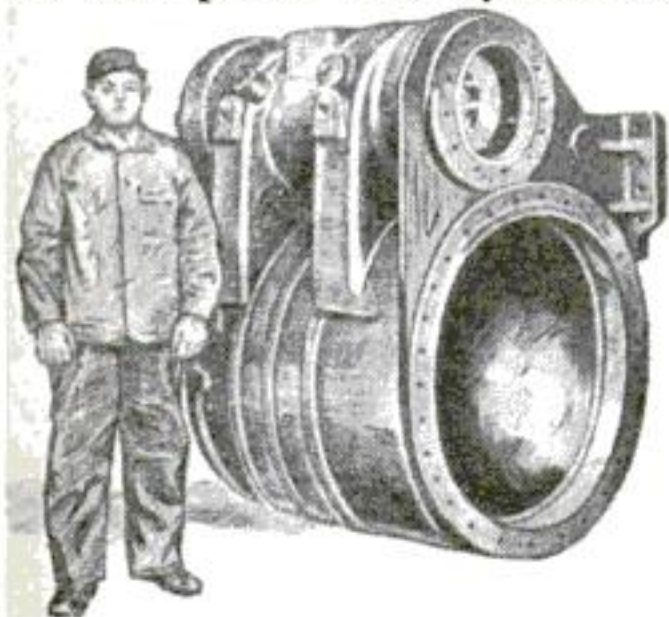
Mallet was right. But his timing was off.

Thirty years later and 4,000 miles away, a new president of the Baltimore & Ohio tossed a bundle of old drawings and technical papers on the desk of his chief mechanical officer. "Look these over," said Leonor F. Loree. "They might hold the answer to the grades and dog-legs on this offensively scenic pike."

James Muhlfeld studied the plans and clippings his sharp and widely traveled

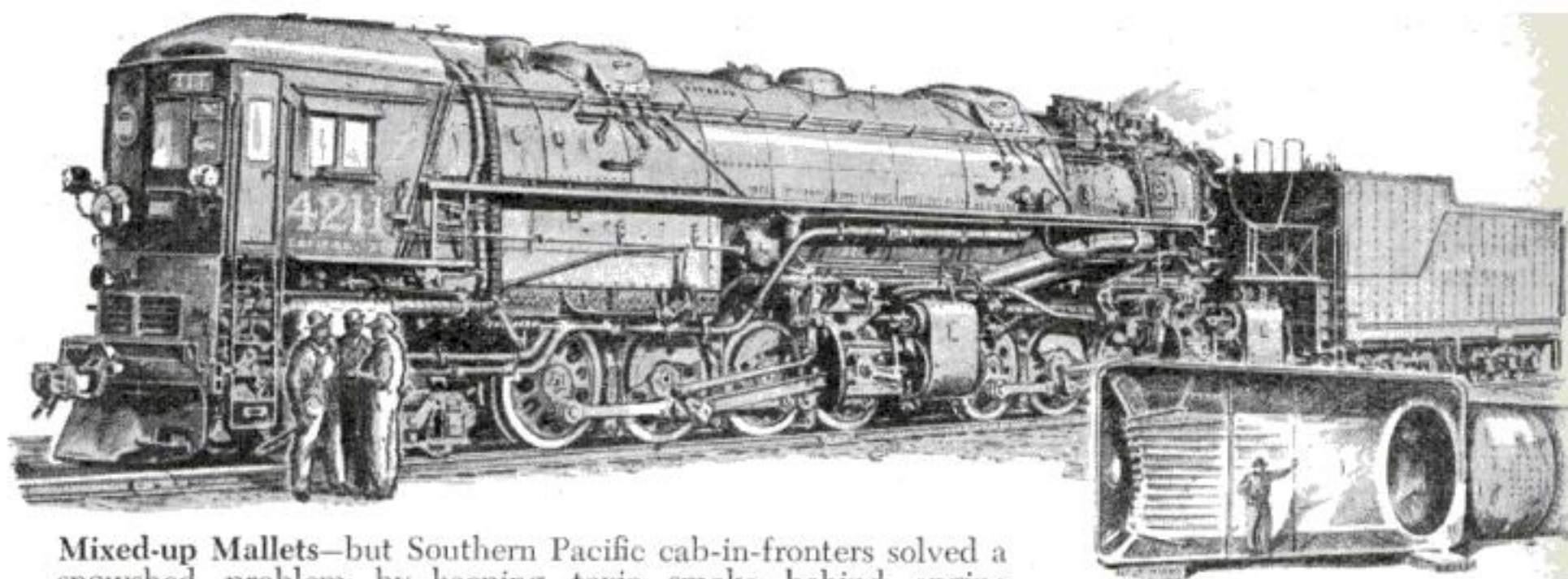
Because they couldn't make steam as fast as they exhausted it, Erie "Triplexes" were used for short pusher runs. Cylinders were master-

pieces of sand-mold casting in 1916. In later years, whole engine frames, including cylinders, were poured as integral units.





ever buckle into America's toughest railroad grades again



Mixed-up Mallets—but Southern Pacific cab-in-fronters solved a snowshed problem by keeping toxic smoke behind engine crews. Boilermaker, standing in outer shell of firebox, points up size of furnace needed to produce 6,500 horsepower.

boss had rounded up on Mallet's locomotives. By then, a fair number were skittering around the Pyrenees and Alps.

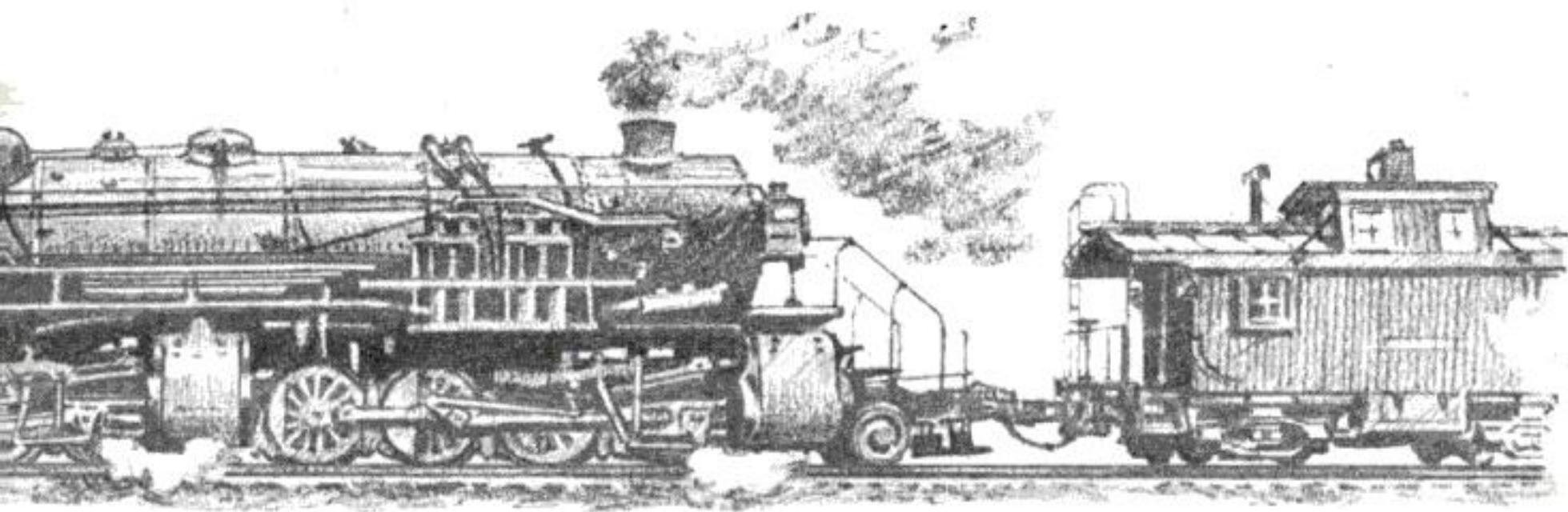
**Strange little kettles.** Muhlfeld liked the unique hinged-engine feature. To get more power over crooked rails, other designers had coupled two small locomotives back to back, with a single cab between them. This limited fuel storage close to the fire doors and doubled boiler maintenance.

Mallet had sidestepped both objections. Under the rear course of a single boiler, he had fastened—rigidly—the second of two driving engines. The other, or forward engine, was coupled to its mate but not connected to the boiler. Instead, it carried its share of the barrel on a sliding bearing. This let it fan from side to side to meet oncoming curves.

A second attractive feature was “compounding.” That trick—making steam voided from a small, high-pressure cylinder work just as hard again in a big, low-pressure cylinder—wasn't new. But Mallet cleverly drove the rear engine unit with steam fed directly from the boiler. Then he ran the exhaust through swiveling pipes to the forward engine.

What intrigued Muhlfeld most, however, was a recent Mallet statement: “Since conventional locomotives have about reached their ultimate in size, the railroads will soon be forced to accept my design.” This was a switch from his earlier accent on compact power—and a disinterested prophecy: His patents had expired.

**Wonderful “Old Maud.”** Soon afterward, a highlight of the St. Louis Ex-





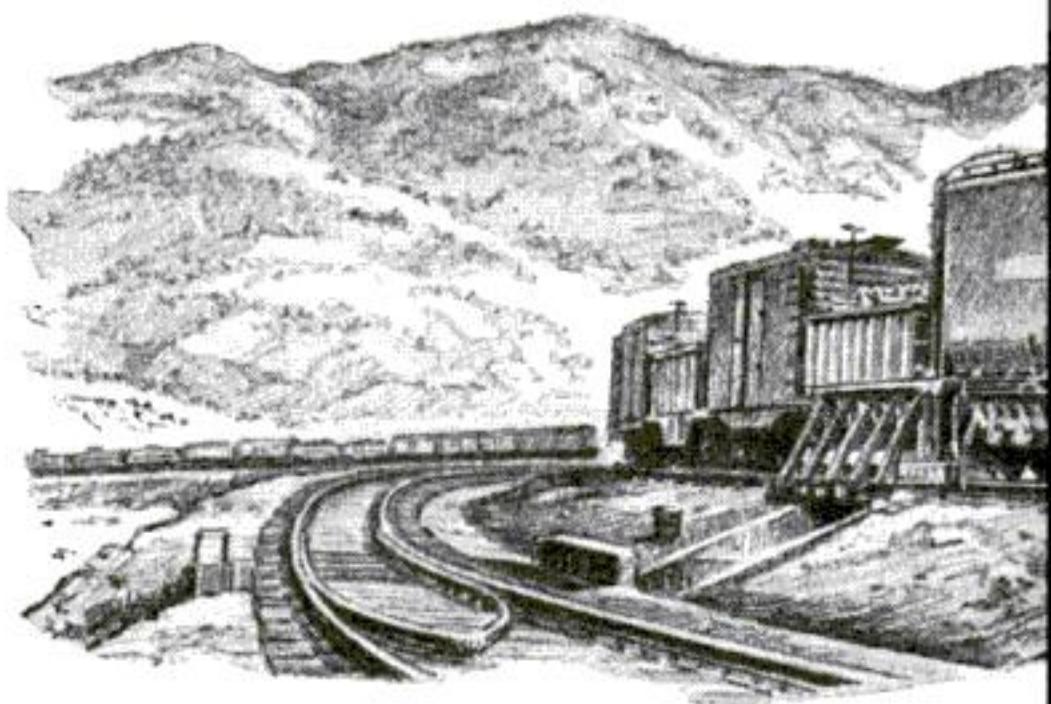
## They labored over the Appalachians, Rockies, and Sierras hauling

position of 1904 was the world's biggest locomotive: an "articulated Mallet compound." It was designed by the B&O to take the place of two standard pusher engines. Delivered by American Locomotive just in time for the fair, there had been no time to test the 80-foot-long monstrosity. Looking at her king-size boiler, precariously poised on 12 driving wheels, engineers predicted she'd do a flip as she nosed into her first curve.

But they ate crow when the Mallet was put to work on the railroad's big hill out of Connellsville, Pa. She soon proved she could do more than eliminate a pusher. Coupled to the head end of a train half again as heavy as ones rating a helper, she waddled uptrack, unaided, gulping three tons of coal an hour. Her crew promptly nicknamed her "Old Maud," after a popular comic-strip mule.

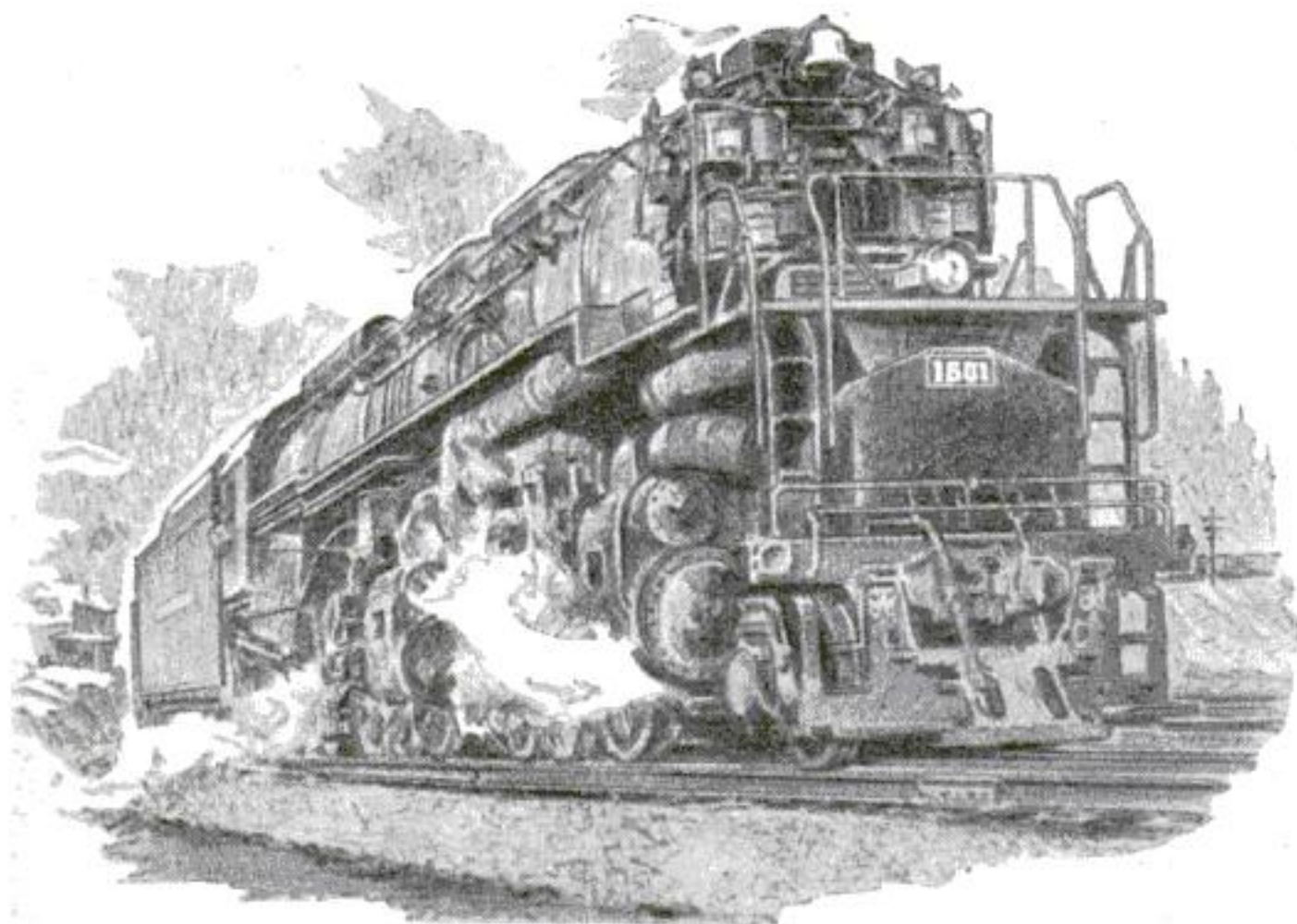
Muhlfeld had ironed out a lot of wrinkles to turn a small and agile locomotive into a well-mannered mastodon. An air-powered reverse gear controlled both sets of cylinder valves, accurately and simultaneously. A spring-centering device held the engine units stiffly in line on straightaways. And an ingenious valve, placed

**Longest and heaviest Mallets ever built,** Union Pacific's 25 "Big Boys" packed 7,000 horsepower to handle heavy tonnage over Utah's Wasatch Mountain grades. Left-hand track favored eastbound movements through the spectacular Echo Canyon, out of Ogden.



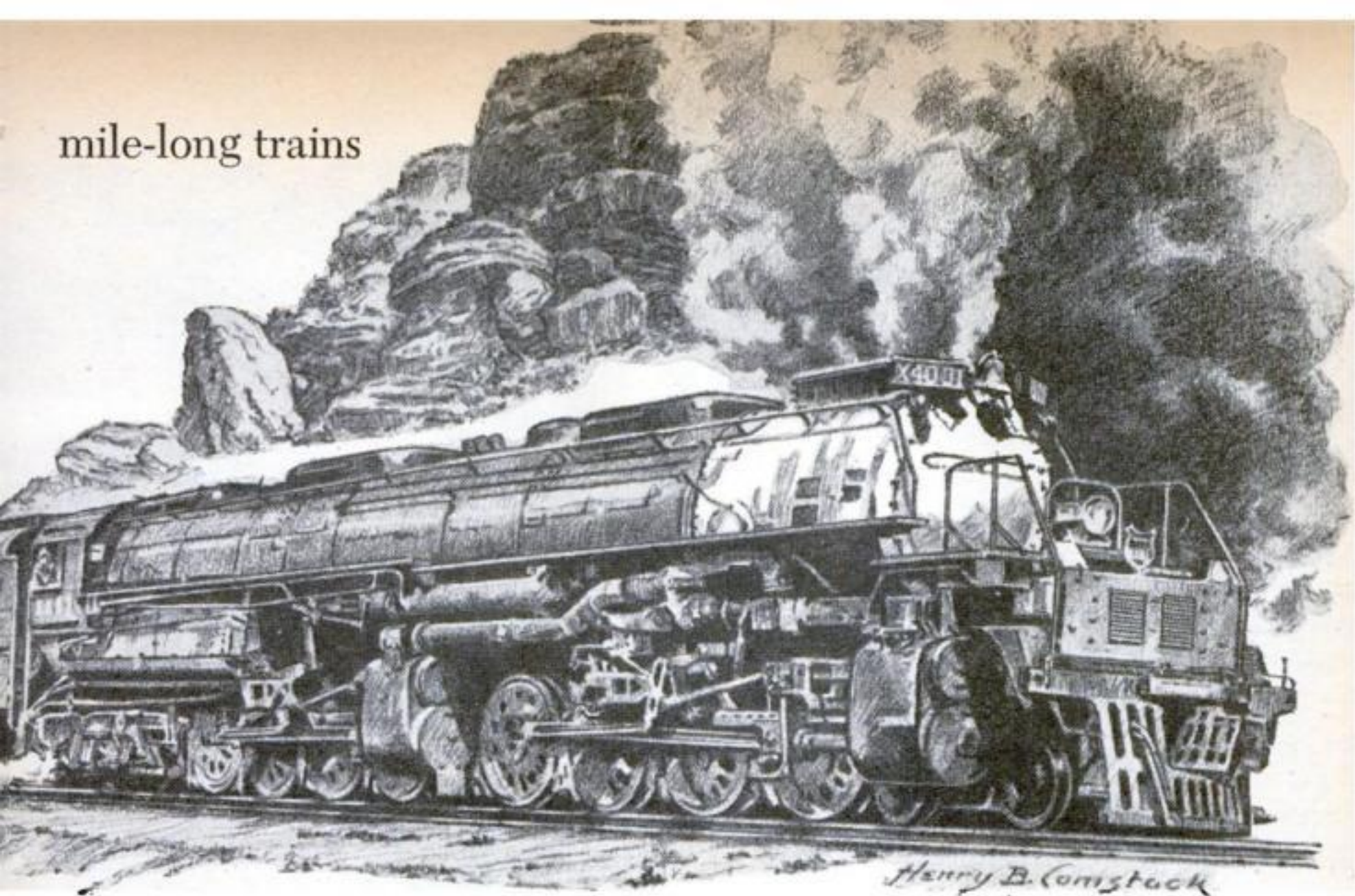
beyond the throttle, poured high-pressure steam into all four cylinders at starting—then automatically switched to compound position at four miles an hour. Without it, ambitious engineers would have been tempted to work the giant "simple" until they bled the boiler to death.

Old Maud's success triggered a chain



Air pumps of the Chesapeake & Ohio's ample-boilered "Alleghenies" were bracketed high on their foreheads—one way to let them squeeze through tight tunnels. For traction, 10 tons of sand was stashed away in twin domes. You can see one of these giants in the Henry Ford Museum, Dearborn, Mich.





reaction. One mountain-plagued line after another went all-out for Mallets, and each order was for ever mightier machines.

That meant more impressive wheel arrangements. Old Maud was an "0-6-6-0." In railroad shorthand: no small guiding wheels—six coupled drivers—six more coupled drivers—no small trailing wheels. Next came 2-6-6-2s, better stabilized for road service. Then 0-8-8-0s for heavy pusher duty, and 2-8-8-0s for beefier sustained running.

*Too many legs, not enough steam.* It was easy to add wheels—but ever-bigger boilers presented a problem. Until 1911, Mallets were hand-stoked, and there was a limit to the coal even a righty and a southpaw swinging scoops alternately could slug onto the grates. That, in turn, limited the size of the closed boiler section—the steam-making part filled with water and honeycombed with fire flues.

To compensate, a long open section was placed up front. Then a big drum was tucked inside, and cut into a round-about water line running from the supply tank in the locomotive tender to the closed boiler course. With this setup, hot gases, bursting from the flues on their

way to the stack, preheated cold water before passing it along to the steam-generating area. These primitive feedwater heaters worked reasonably well, but had an unhappy way of collapsing after a few months. Electrolysis, caused by the sharp difference in temperature between closed and open sections, did the damage.

One road—the Santa Fe—got even more grief by ordering Mallets with hinged boilers. To eliminate overhang on curves, a set of steel bellows connected the two parts of the barrel. But cinders, bouncing into the accordion-pleated folds, kept bursting them.

*Everybody gets into the act.* The automatic stoker—at first a crude conveyor-belt rig that dribbled fuel through the mouths of numerous chutes—brought some relief. As awkward as it was, it cleared the way for 12 fantastic 2-10-10-2s in 1913. Ten were built by American Locomotive for the coal-hauling Virginian Railway. The other two were do-it-yourselfers. The Santa Fe simply scrambled parts of outmoded conventional locomotives.

Not to be topped, the Erie, working with the Baldwin Locomotive Works,

[\[Continued on page 170\]](#)

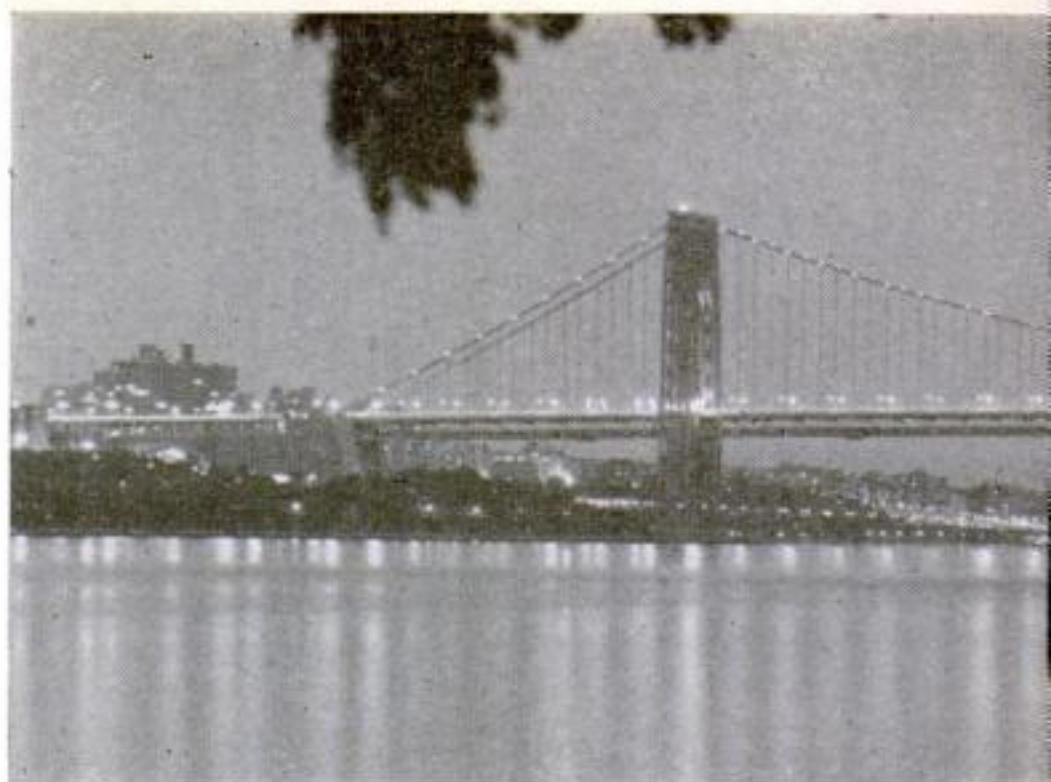


## Second deck added to make big bridge world's largest

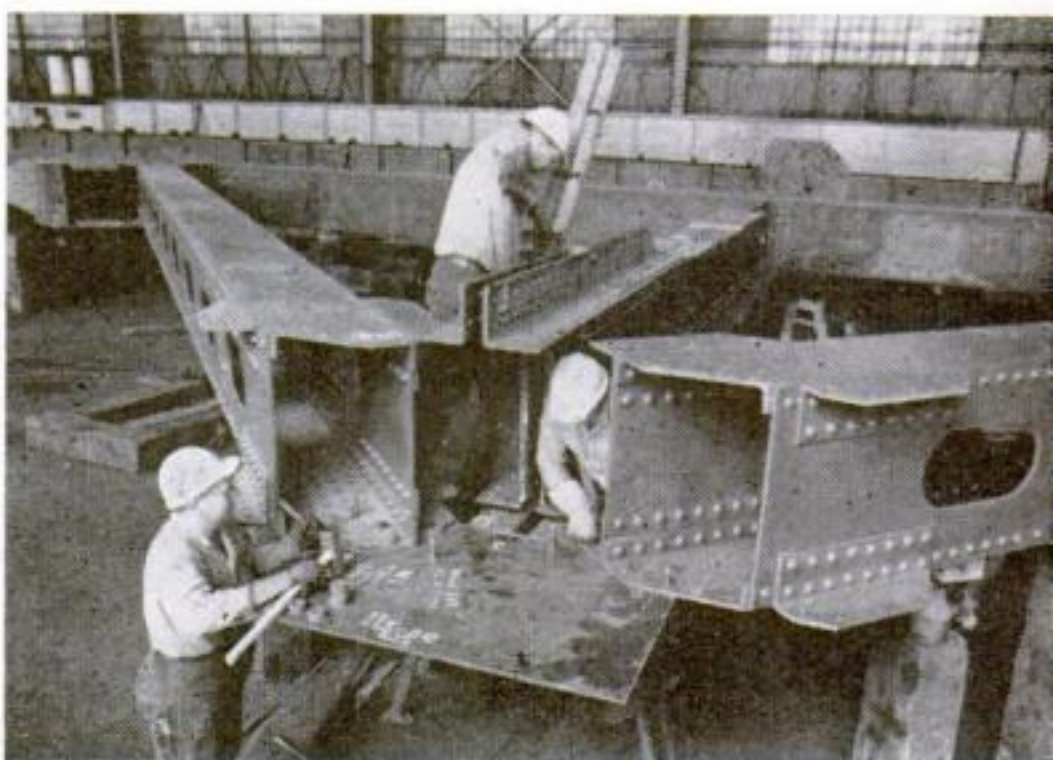
Considered by many the world's most beautiful bridge, the George Washington Bridge between New York and New Jersey became, this fall, the world's biggest as well. A second deck was opened, giving the Hudson River span a total of 14 lanes that will enable 70,000,000 cars, buses, and trucks to cross it a year.

Double-deck bridges aren't new—San Francisco's Oakland Bay Bridge was built that way from scratch. But adding a second deck to an old bridge, especially one of this size (its 3,500-foot span is the third longest) is something else again. Bethlehem Steel engineers brought new, complex methods into play. They added the lower deck without closing down even temporarily, and without interrupting the upper-deck flow of 100,000 vehicles a day during four years of construction. Yards on both banks of the river assembled 75 huge 220-ton steel deck sections 108 feet wide and 90 feet long. They were raised on trolleys working on tracks under the structure.

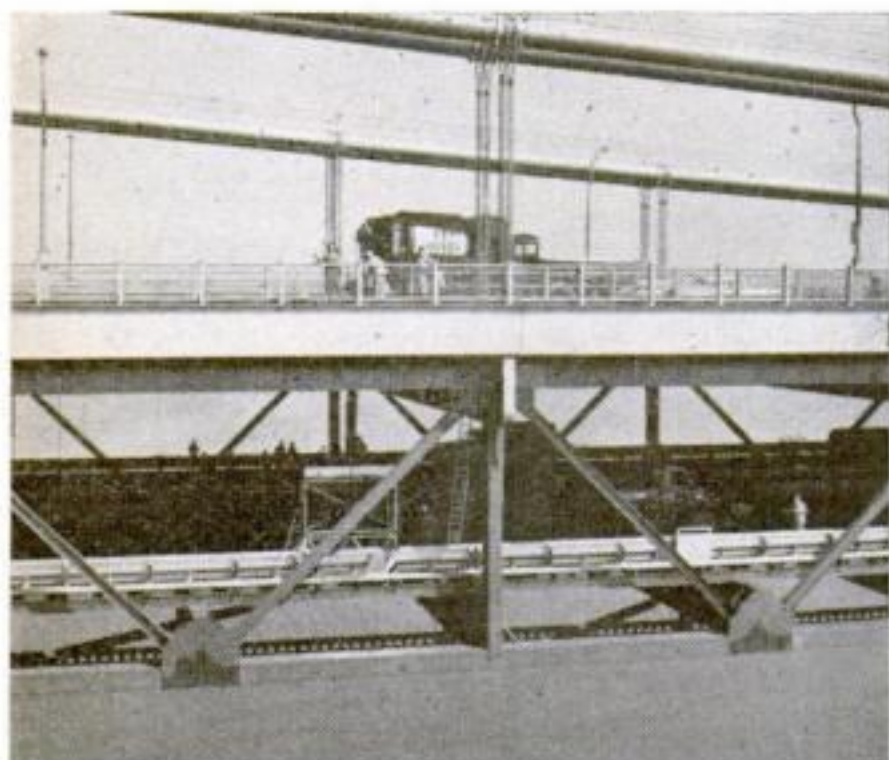
The bridge, built in 1931, was designed to take a lower level when it was needed. New work cost \$21,000,000. Approaches brought the added cost to \$145,000,000.



Still the world's most beautiful, George Washington



1. Trusses were assembled in 60-foot chords for 4,760 feet of deck, tried in Bethlehem's Pottstown plant to insure final fit in field.

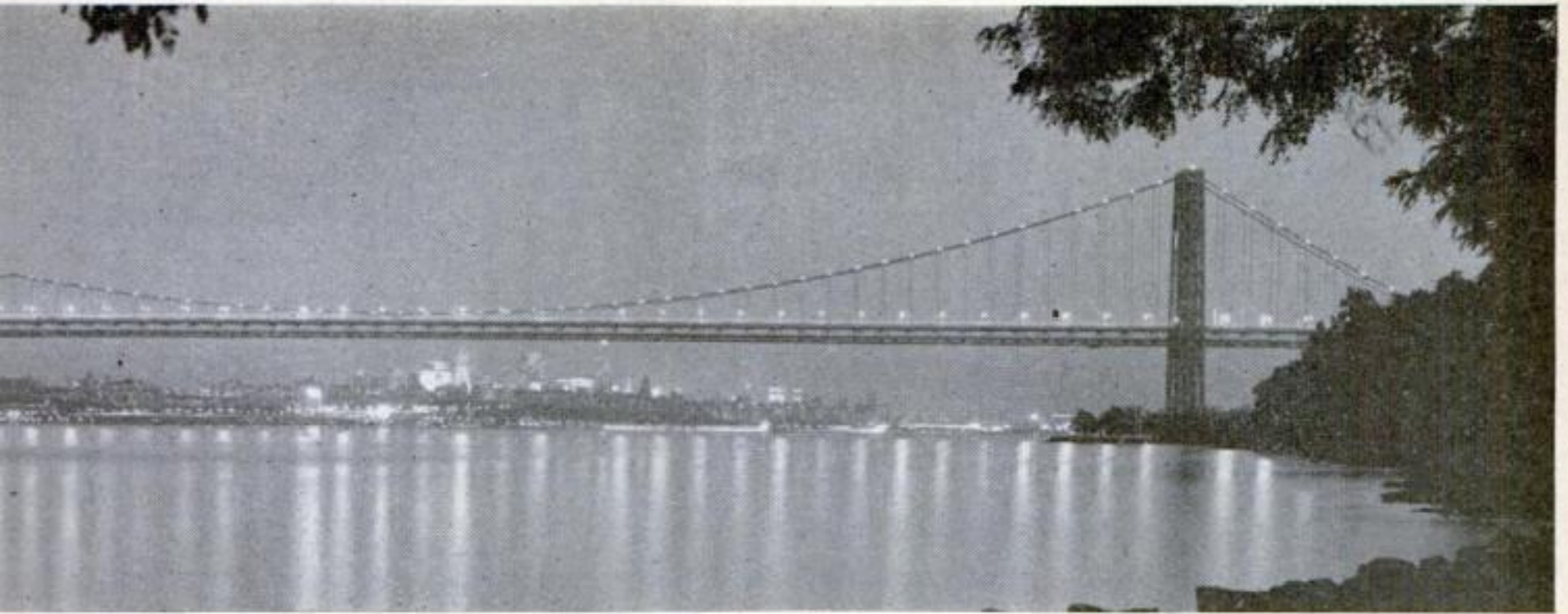


4. Concrete is poured from upper deck through chutes in temporary holes. It took 5,000 square yards to cover span to 4½-inch depth.



5. Loaded into hoppers on lower level, mix was distributed by motorized spreaders from center outward in order to keep added weight even.

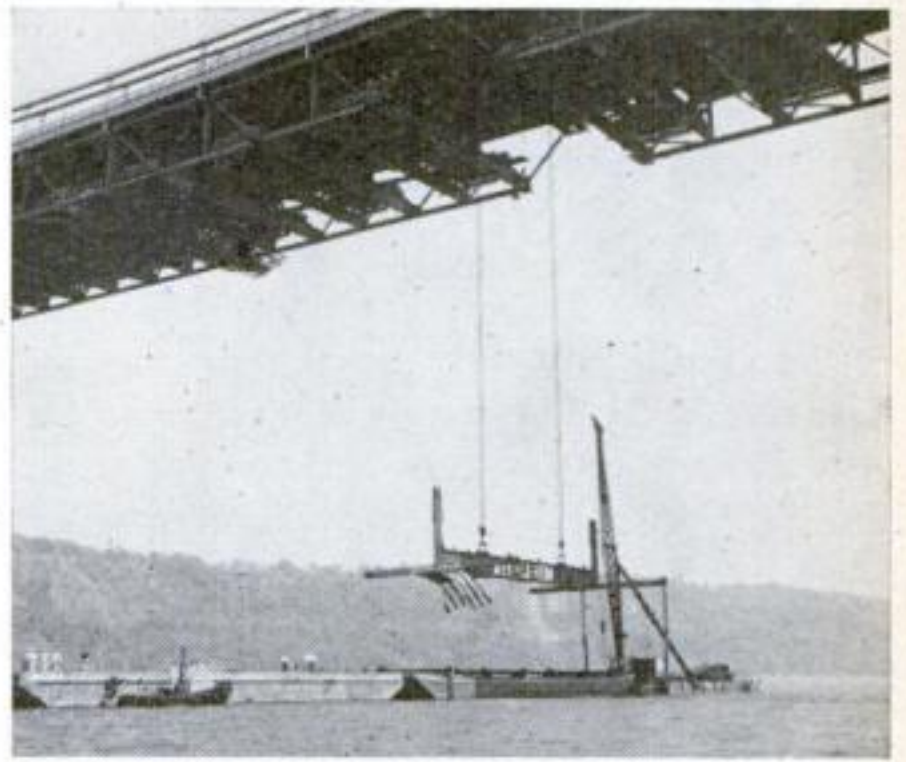




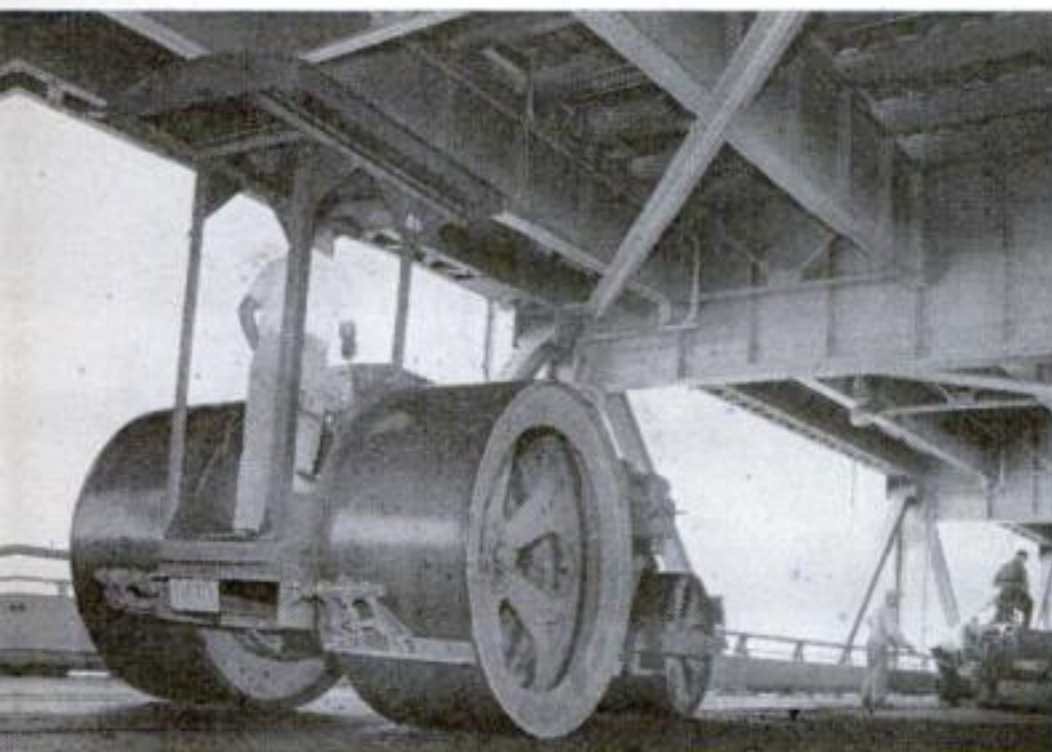
Bridge loses none of its gracefulness by addition of lower deck to take six more lanes of traffic.



2. Huge 220-ton section is raised into place and riveted near tower at New York end. Work then alternated from both ends toward middle.



3. Flag flies on final assembly as it's lifted from barge to center of span. Construction took four years without interrupting traffic.



6. Final step in paving operation is coating concrete base with 1½-inch blacktop wearing surface and compacting it with heavy rollers.



7. Opened to traffic, six-lane lower deck can handle nearly 30,000,000 cars a year, makes span only 14-lane suspension bridge in world.



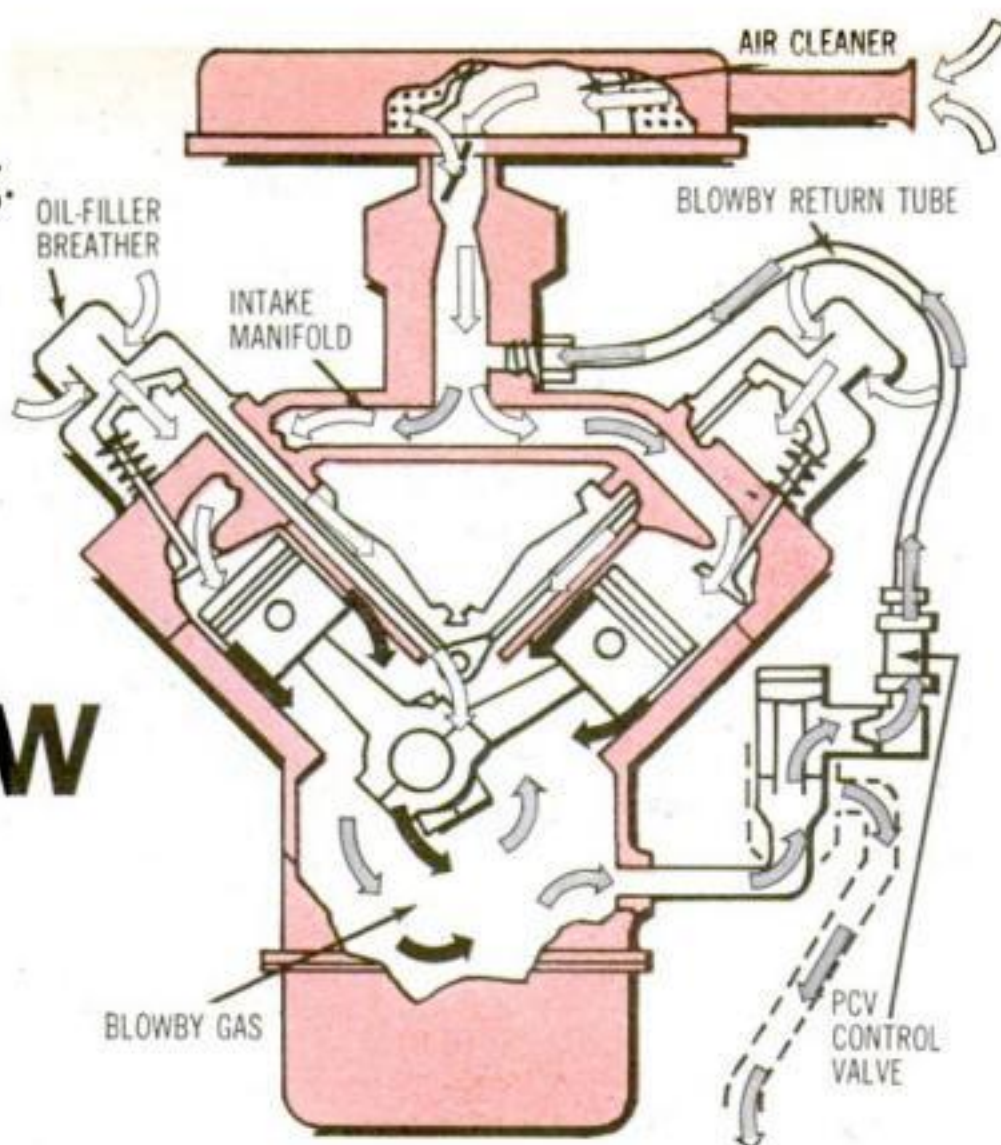
Positive crankcase ventilation  
—now on all '63 cars—cuts smog.  
But it can cause you trouble  
if not regularly serviced

# What You Should Know About PCV

By Devon Francis

**I**F YOU have bought, or are going to buy, a 1963 car, you very shortly will have a brand-new servicing chore on your hands. To keep your vehicle running right, its intake system will require the ministrations of a mechanic a couple of times a year. Your dealer, service station, or independent garage can do the job. Or you can do it yourself.

The cost: from \$3 to \$5 if it's done for



The three PCV systems are illustrated in these drawings. The AC system, dumping blowby directly into the intake manifold, uses a valve to maintain the correct air-fuel ration. Next, the

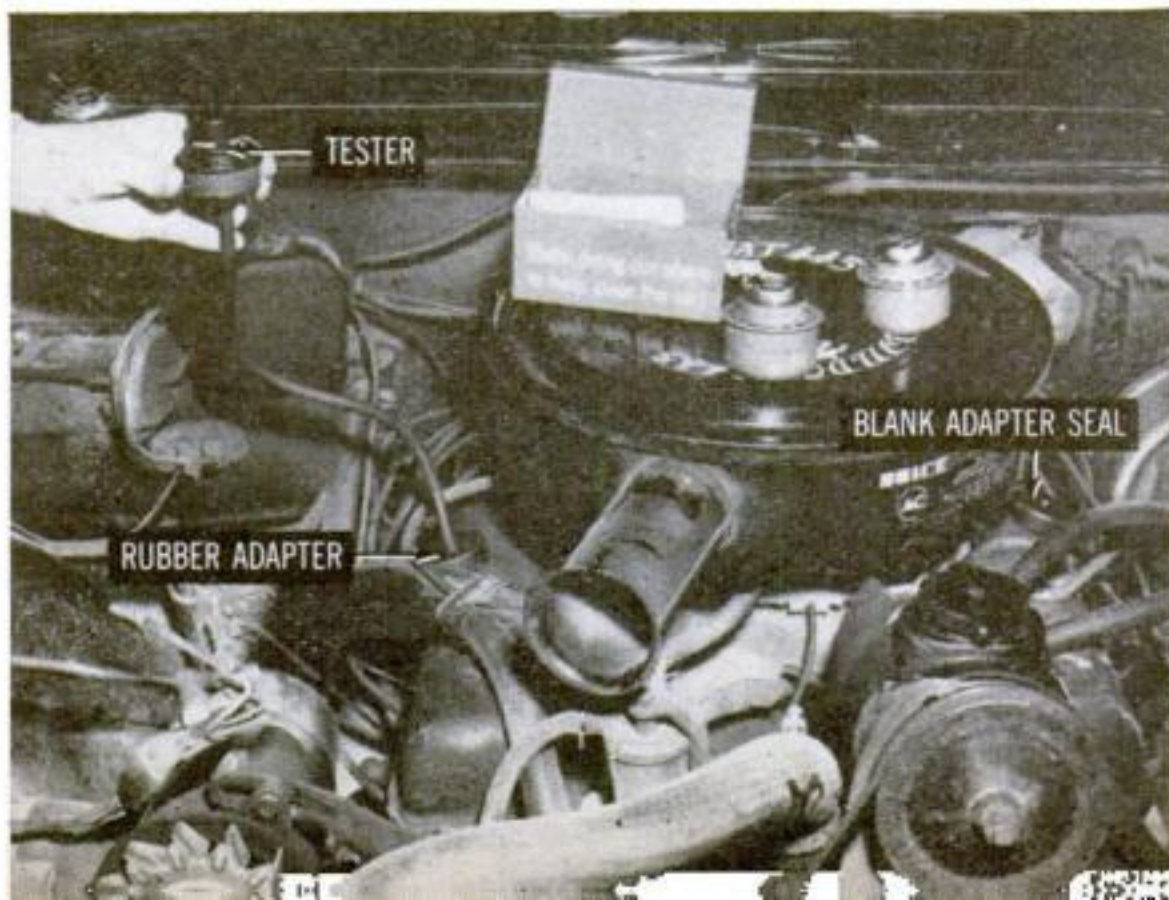
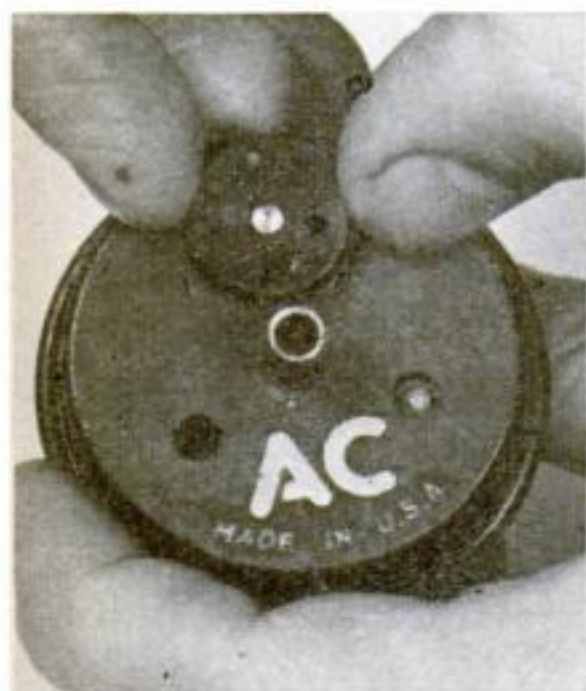
you, from nothing at all to about \$2 if you want to dirty your hands.

The reason: Something new has been added to automobile engines. Listen hard now, because if your car falls ill, it may have no more than blowby colic. What

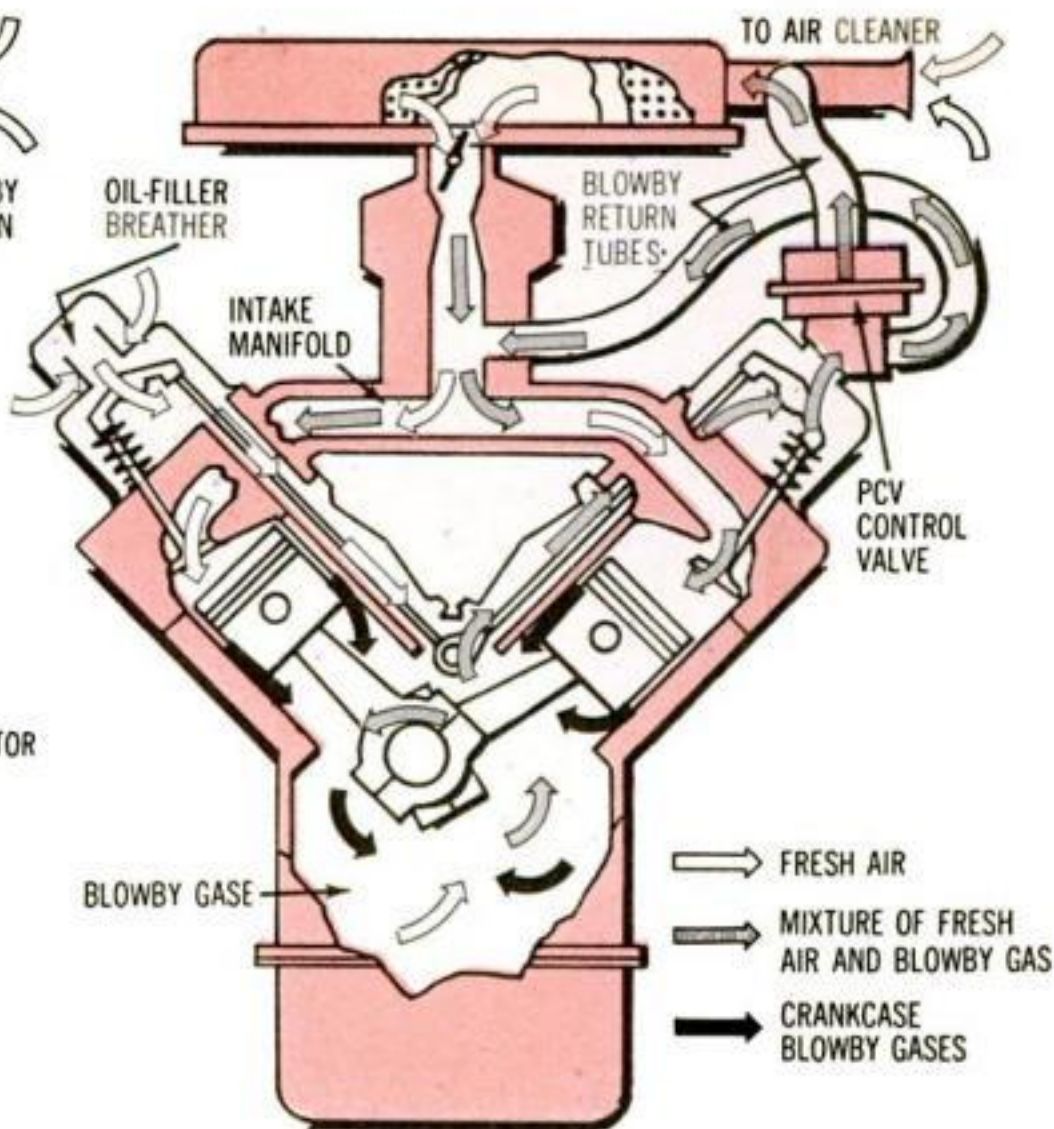
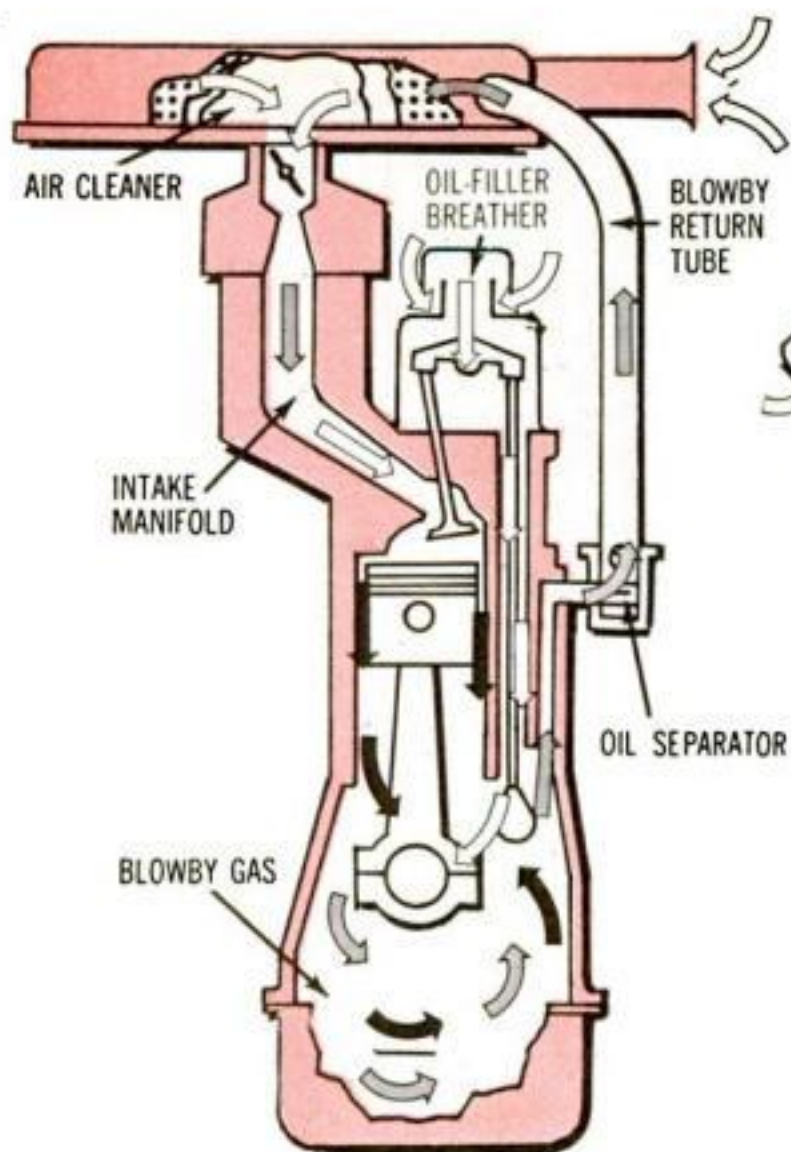
## AC system should be tested each 5,000 miles for efficiency

First step in testing is setting selector knob on bottom of test instrument for make, year, and model of your car's engine.

Now replace crankcase breather cap with rubber adapter. Connect rubber tube to adapter and base of tester. Seal all other crankcase vents with blank adapters. Idle engine. Green signal means okay, red a reverse flow, yellow no flow at all.







Ford system, used on that company's six-cylinder engines, routes blowby directly to the air cleaner. A filter returns oil mist to the crankcase. Finally, the Olds system employs two

routes to return blowby to the cylinders. At idle, a valve pours the gases into the intake manifold. As the engine speeds up, they go to both the air cleaner and intake manifold.

has been added to automobile engines for '63 is called PCV (for "Positive Crankcase Ventilation"). While the servicing consumes time and/or money, it has its happier side. PCV will give you a cleaner engine and extend its useful life.

**How PCV works.** PCV draws unburned fumes (blowby) from an engine's crankcase and returns them to the cylinders for combustion. Blowby is a mixture of burned and unburned gases that get forced past piston rings on the compres-

CONTINUED

## Disassembling, cleaning, and replacing valve takes a half-hour

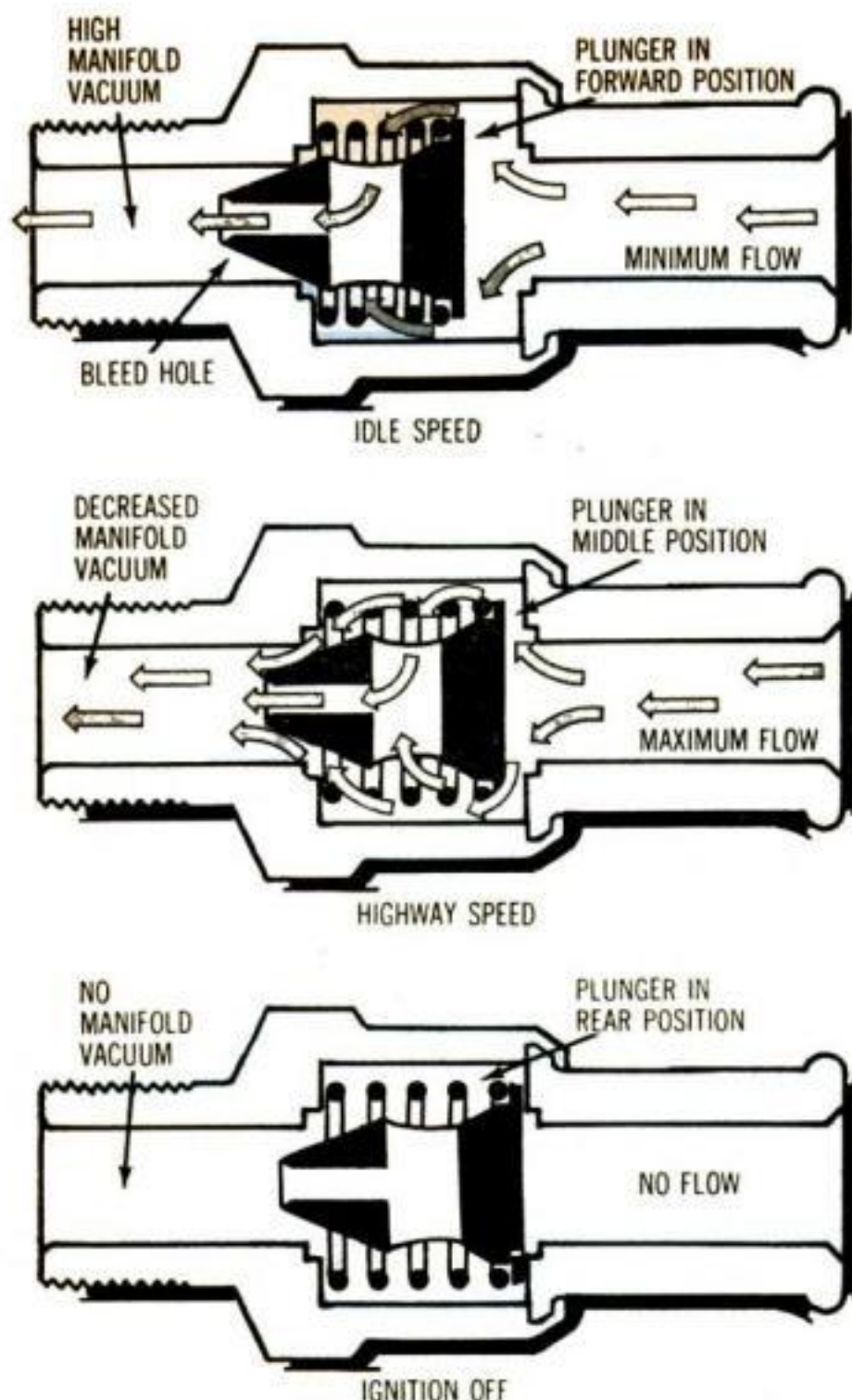
To clean AC system or replace valve, disconnect the hose and remove the valve. If hose is obstructed, replace it.

Disassemble the valve next (but watch sequence so you can put the parts back together again in exact reverse order).

Soak all the parts in a solvent, stroking with a brush. One caution here: Be careful not to distort the spring.







To maintain proper air-fuel ratio with varying amounts of blowby, AC valve plunger seats at engine idle, forcing gas through bleed hole. As revs go up, it unseats, accommodating more gas. If manifold backfire occurs, valve plugs the tube to prevent crankcase explosion.

sion and power strokes. The amount of blowby varies with engine displacement, speed, road load, compression ratio, piston and ring design, and engine wear. PCV is a substitute for the "road draft tube" that has been used to ventilate crankcases in the U. S. for more than three decades. The road draft tube spewed the unburned gases into the air. PCV doesn't. While PCV is new here, it has been common in Europe for many

years. Here it has been used off and on in trucks and some commercial auto fleets since World War II. It is mandatory on all U. S. military vehicles. California has required PCV on new cars for two years.

The simplest way to achieve PCV is to insert a piece of flexible plumbing connecting the crankcase to the carburetor air cleaner. The engine's pumping action, creating suction, draws the gases from the crankcase to the cylinders for recycling.

But most systems are more complex. They have valves that must be serviced.

Small engines can use a simple PCV system because the volume of gas to be recycled is low. Bigger engines (and that includes all V-8s), for now at least, must use more elaborate systems.

While the tube from crankcase to intake and a valve or two would imply that PCV is mechanically primitive, the systems in their variations prove on examination to be anything but. They have to do their job within rigid limits set by the auto industry.

PCV must not draw oil from the crankcase in any substantial amount, contribute to crankcase explosions, adversely affect engine or car operation, contribute to a noxious or toxic effect on the outside air, or cause a carburetor air-fuel ratio change beyond one percent richer or four percent leaner. It must operate efficiently for 12,000 miles with normal maintenance.

There are three separate PCV systems. The most widely used, and probably the most efficient, is that developed by GM's AC Spark Plug Division. It is adapted from an AC system devised for U. S. Army trucks during World War II. At its heart is a spring-loaded valve—a plunger—pierced by a bleed hole. The bleed hole



To prevent trouble in valve reassembly, AC gradually is replacing take-apart unit (left)

with one that is permanently crimped together and must be replaced. Cost: about \$2.



is necessary because the plumbing dumps blowby directly into the intake manifold. The blowby flow thus becomes critical to the air-fuel ratio.

One performance debit for this system: The valve momentarily gets hysterical on deceleration from speed, upsetting the air-fuel ratio.

**For six cylinders: no valve.** The simplest of the systems on 1963 cars was developed by Ford for its six-cylinder engines. In this, the tube leads from the crankcase to the air cleaner. A filter in the tube removes oil mist from the blowby and drains it back into the crankcase. Another filter, in the air cleaner, precipitates blowby soot and varnish that otherwise would clog the paper air cleaner.

Ford prefers this system on four counts: It has no valve to clog, it removes most of the oil mist, it requires only a few minutes' attention each 6,000 miles, and it is insensitive to the amount of blowby—that is, the carburetor acts as a cushion against upsetting the air-fuel ratio once it is adjusted.

Ford will use the AC system on its V-8s, however, for 1963 because there is too much blowby in bigger engines to be accommodated by the simpler plumbing of its current design. For 1964 Ford hopes to adapt its own system to its V-8s.

The third system, a switch on AC's, is Oldsmobile's. Playing its customary maverick role, Olds expressed dislike for the AC system's valve complication.

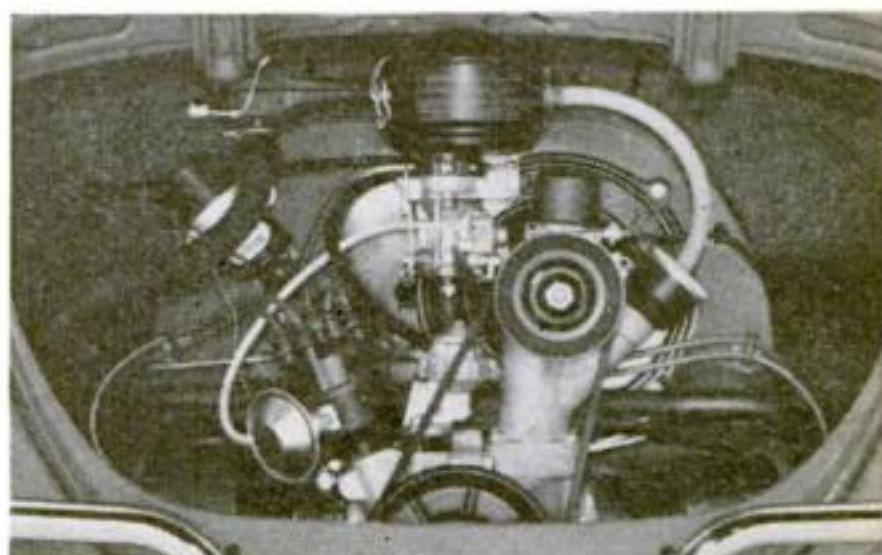
So they devised an extra piece of plumbing containing a simple check valve. AC makes it for them to keep peace in the GM family. At engine idle, the valve closes, dumping blowby into the manifold. As r.p.m.s rise, the valve opens to admit most of the blowby to the carburetor air cleaner.

The dual-action PCV system is used only by Olds. The other two systems are used as follows: AC—all GM cars (except Olds), Ford Motor Co. V-8s, all Chrysler Corp. cars, and American Motors and Studebaker cars with one exception; the Ford system—Ford Motor Co. six-cylinder cars. The exception is a

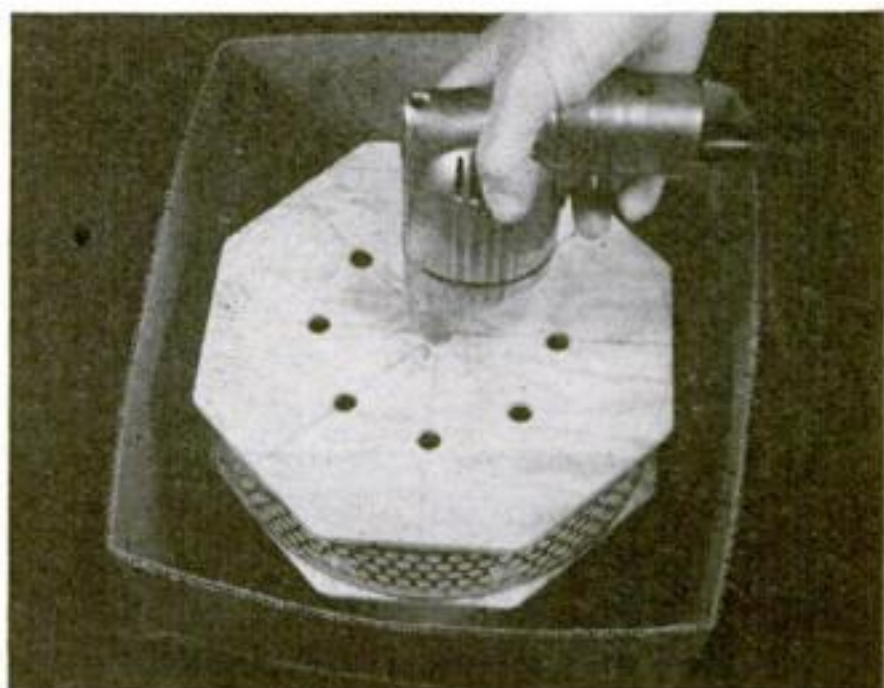
[\[Continued on page 184\]](#)



Housing for simple artificial-rubber valve in Olds dual-path system can be removed for cleaning by any motorist handy with home-workshop tools. Soak it in solvent and replace it.



Least complicated of all the new crankcase ventilation systems is the Volkswagen's. It's a piece of plastic tubing running from crankcase to air cleaner. Cost: about a nickel.



Only part of PCV unit for Ford six-cylinder cars needing attention is the air cleaner. Clap it between two pieces of plywood, attach a quarter-inch drill, and whirl it two minutes. Putting it in a box is only a safety measure.





# Inside Our First Space Station



When you walk, or sit at inflated table, "down" is toward rim.



PS PHOTOS BY W. W. MORRIS

Wearing a space suit, you

Until now, manned space stations existed only on paper—but here's a full-scale one that could actually be put in the sky

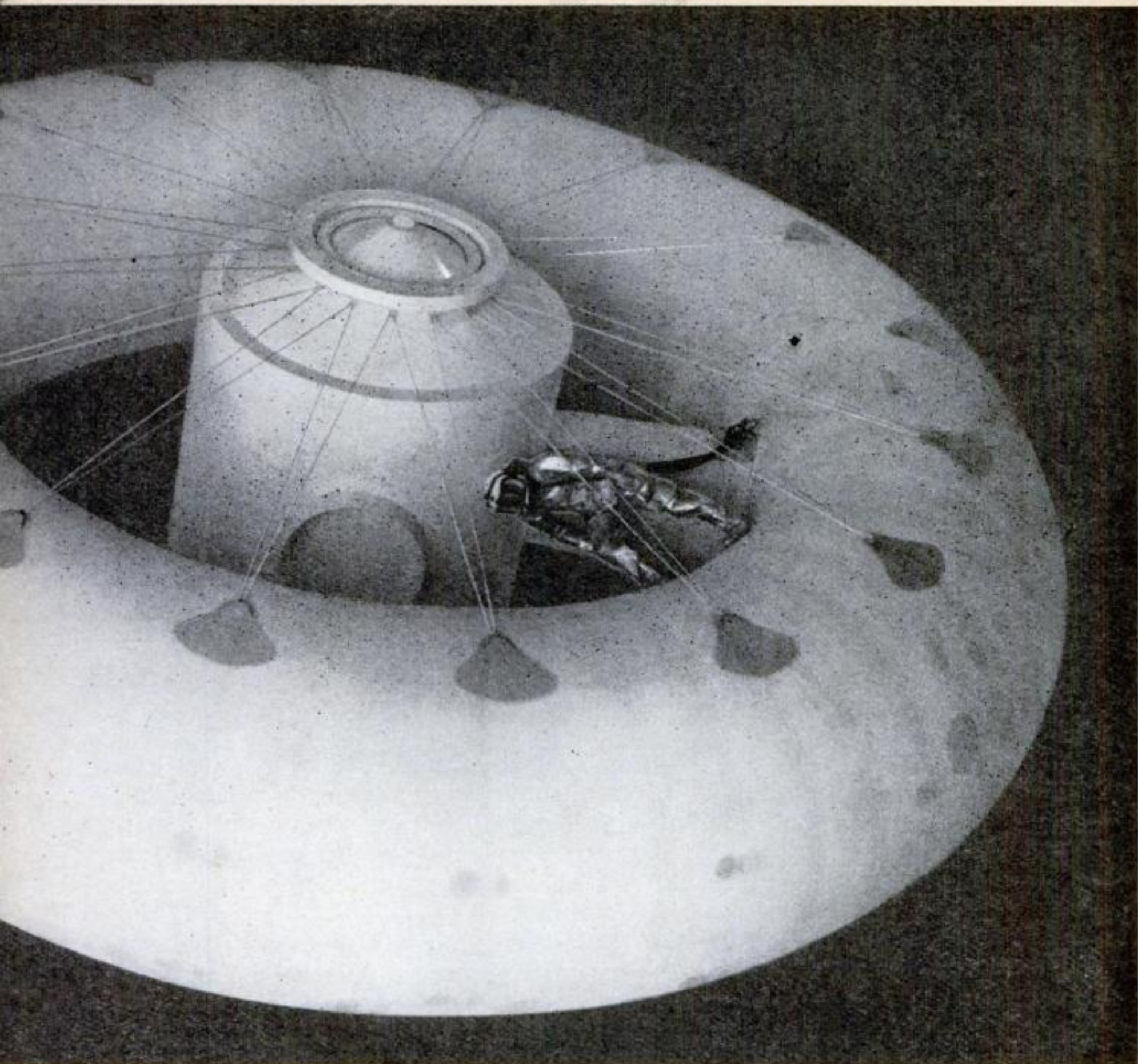
By Alden P. Armagnac

**T**HE strangest dwelling ever built, a gigantic inflated doughnut of rubberized fabric, towers three stories high within an airship hangar at Akron, Ohio. Designed to provide living quarters for 3 to 10 men, the 30-foot-diameter structure is America's first space station—and so far as is known, the first in the world.

Its builder, Goodyear Aircraft Corp., calls it a "full-scale research model" for an inflatable satellite that could be launched into permanent orbit by 1965, to serve as a manned space laboratory and as a way station to the moon and planets.

Its design could readily be scaled up to 150-foot diameter—the size for a space station that its sponsor frankly favors—but the 30-footer itself, Goodyear ex-





can go outside 30-foot "doughnut." Photos have been tilted to show how it would appear in orbit

perts maintain, is a perfectly practical version. With the addition of some finishing touches such as solar-cell panels and jet nozzles, the one in the Akron hangar could actually be launched into orbit and manned.

A single rocket shot would put up this 1,800-pound pneumatic dwelling. Deflated and collapsed, it can be packed into the capsule of a rocket such as an Atlas-Centaur, and launched into an orbit 200 to 500 miles high—above the earth's atmosphere, below the Van Allen belts of dangerous radiation. Automatically inflating itself, it will be ready

for occupancy by its crew of spacemen.

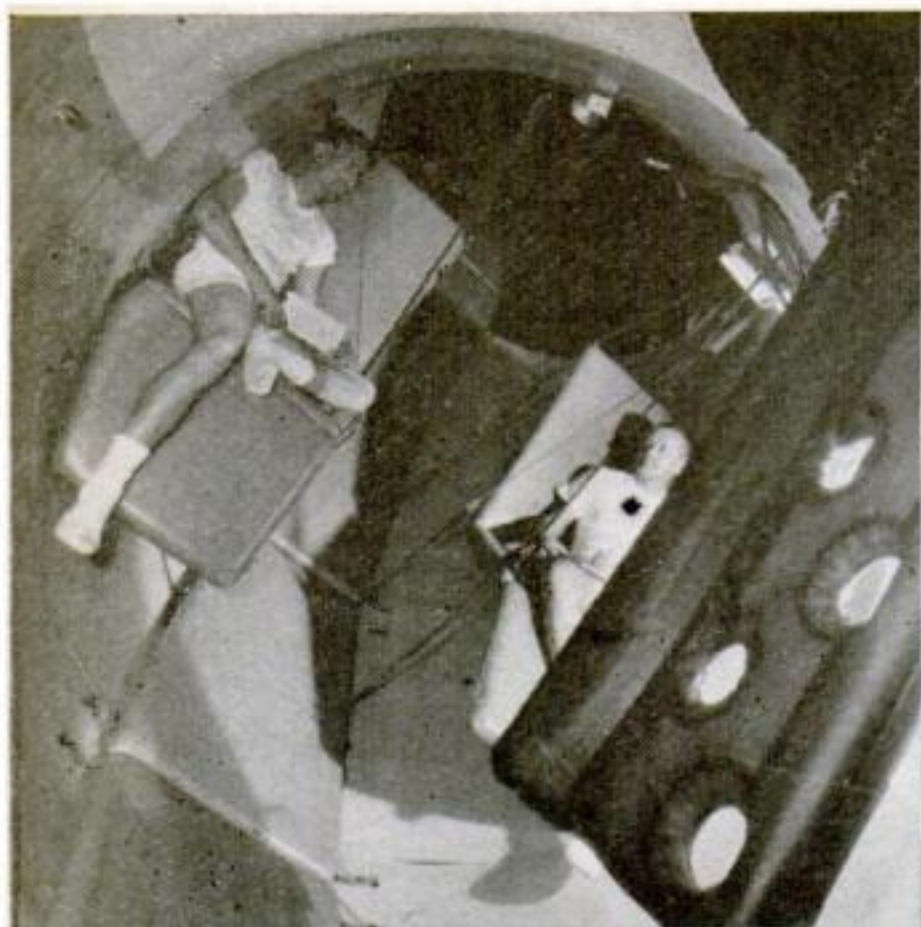
Astronauts boosted to its orbit—in Gemini- or Apollo-style capsules—will rendezvous with the space station, enter it through an airlock, and set up house-keeping in space. At intervals of perhaps two to six weeks, a new crew will relieve the previous occupants, who will return to earth.

What will it be like to live in a space station? An inside-and-out tour of the 30-footer—now suspended vertically by its aluminum hub and a single spoke—gives this first-hand view:

*You enter the doughnut* through a cir-



What living aboard an orbiting space station will be like is shown by



**Inflated furniture** of tubular living quarters includes reclining chairs, convertible into bunks, in background. Novel inflated ladder to hub, in right foreground, has holes for steps.



**Breakfast on a space station** may be ham and scrambled eggs—shown dehydrated in packet at right, and prepared by adding hot water. Other packets hold Spanish rice, beef with gravy.

cular opening at one end of the hub. This is where a manned capsule will arrive and dock, so its occupants can pass directly from it into the station.

A slide fastener zips open the space home's "front door," a rubberized-fabric panel. You step into an airlock in the hub, closing the panel behind you. Passing through a similar inner door, you descend a ladder within the three-foot-diameter spoke of inflated fabric.

You're in the station's living quarters—an endless tube. Plastic wallpaper lines it, pale green halfway up and then white. Its seven-foot headroom gives ample clearance to walk erect. The odd thing is that the brown floor curves upward ahead of you, much too steeply to climb.

But a crewman will stride along it as if it were flat. To him, wherever he stands, "down" will be toward the doughnut's rim, and "up" toward its hub. In space, that will be the result of the station's artificial gravity—the centrifugal force exerted by its slow rotation, at about four r.p.m. Set spinning by a brief impulse from jet nozzles on the rim—

which also control the doughnut's tilt—the station will continue to rotate. That will not hinder the docking of a man-carrying capsule, which could couple to a roller-bearing swivel ring attached to the hub.

Whether artificial gravity will be needed to prevent ill effects from prolonged weightlessness has still to be learned. But in any case, it will be a decidedly practical convenience—to enable the crew to sit and walk about naturally, and to keep objects from floating in mid-air. Weightlessness will prevail only in the hub—where centrifugal force is zero—and a crewman will feel his weight returning as he descends to the rim.

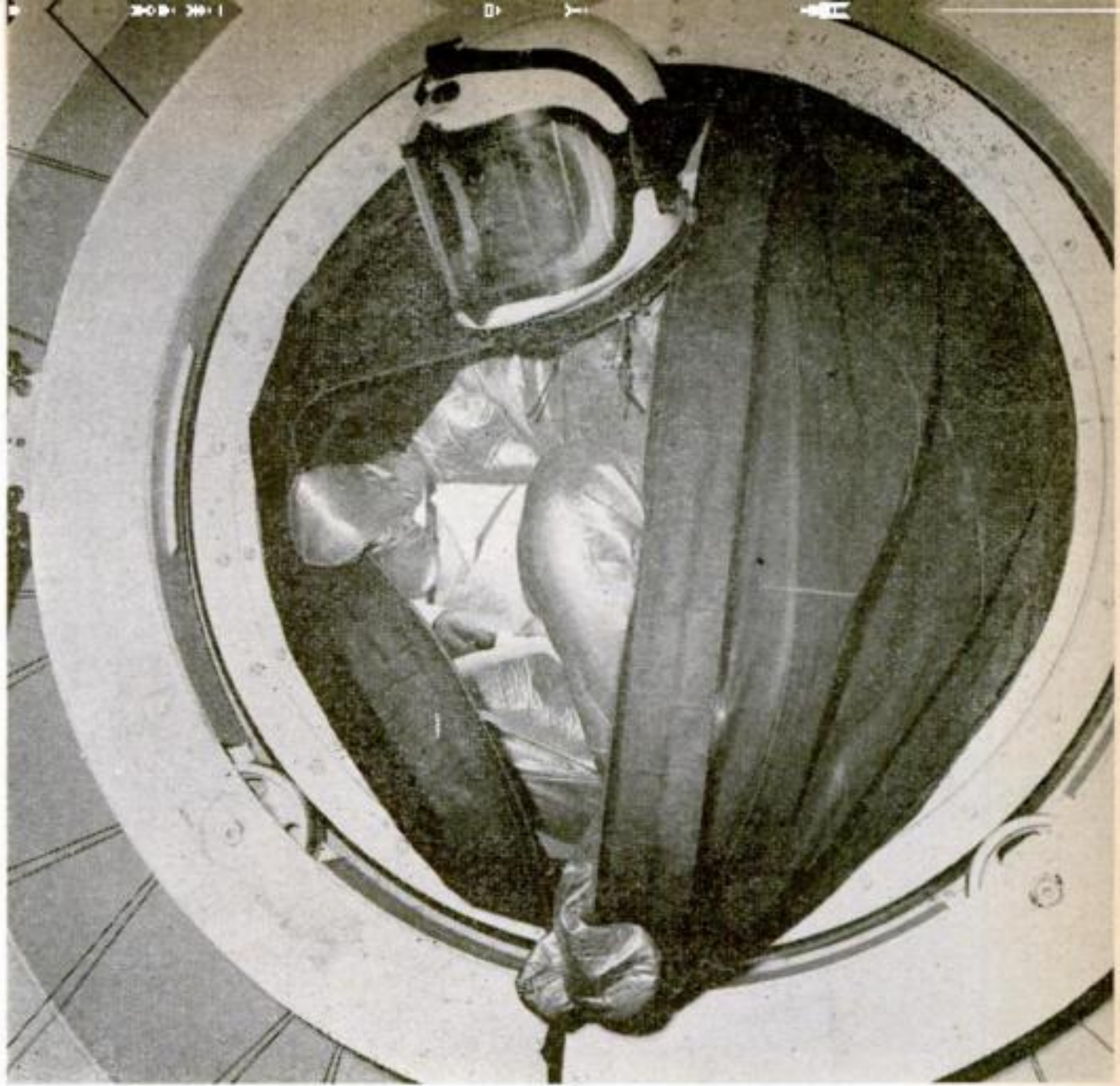
*For the space station's furniture*, the designers have developed novel inflated seats, desks, tables, and combination bunks and reclining chairs—which, like the doughnut's tube, are collapsible for launching. So is the inflated flooring, which has a slightly squishy feeling in stocking feet or sneakers—the only foot-gear permitted, to safeguard it from damage. Even the ladder is of inflated



a full-scale version



To venture forth from space station, you ascend ladder to hub (above). Fully clad in space suit and helmet, you emerge through outer door of airlock (right). A slide fastener opens door or closes and seals it airtight.



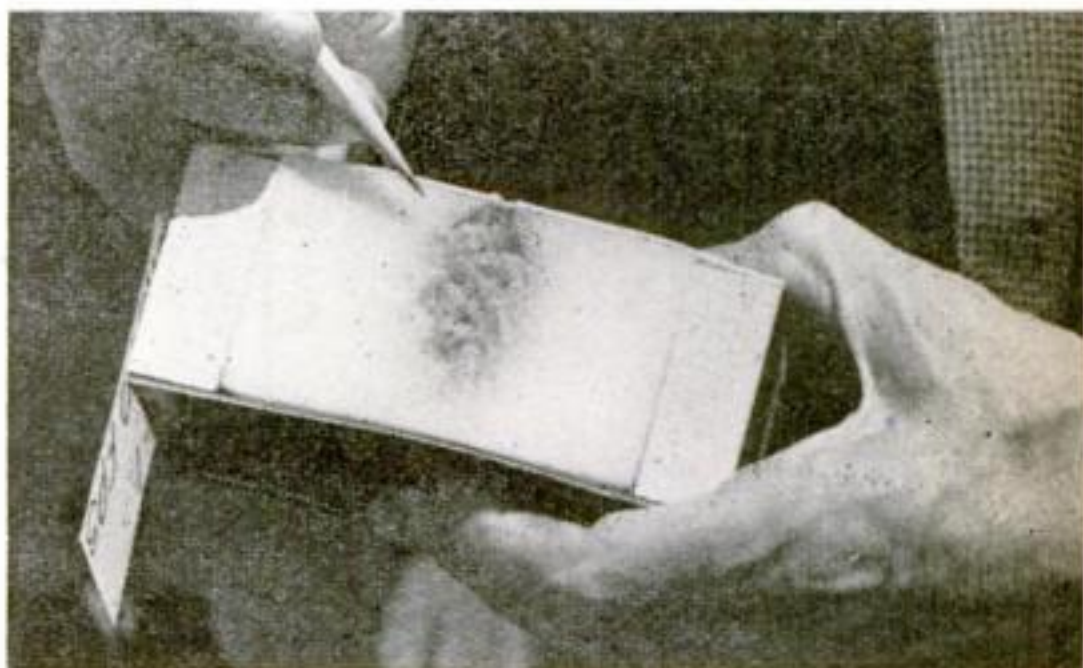
fabric—a curious affair with round holes instead of rungs for footholds. All of these fill with air at the same time that the doughnut inflates itself.

Meals will be tasty and filling—if not exactly gourmet style. A galley will be stocked with weight-saving dehydrated foods in plastic packets, prepared simply by adding hot water. Currently a variety are being developed especially for spacemen. A typical space-station menu: Breakfast of ham and eggs, lunch of chicken and rice, dinner of beef and gravy, all now available in the plastic envelopes.

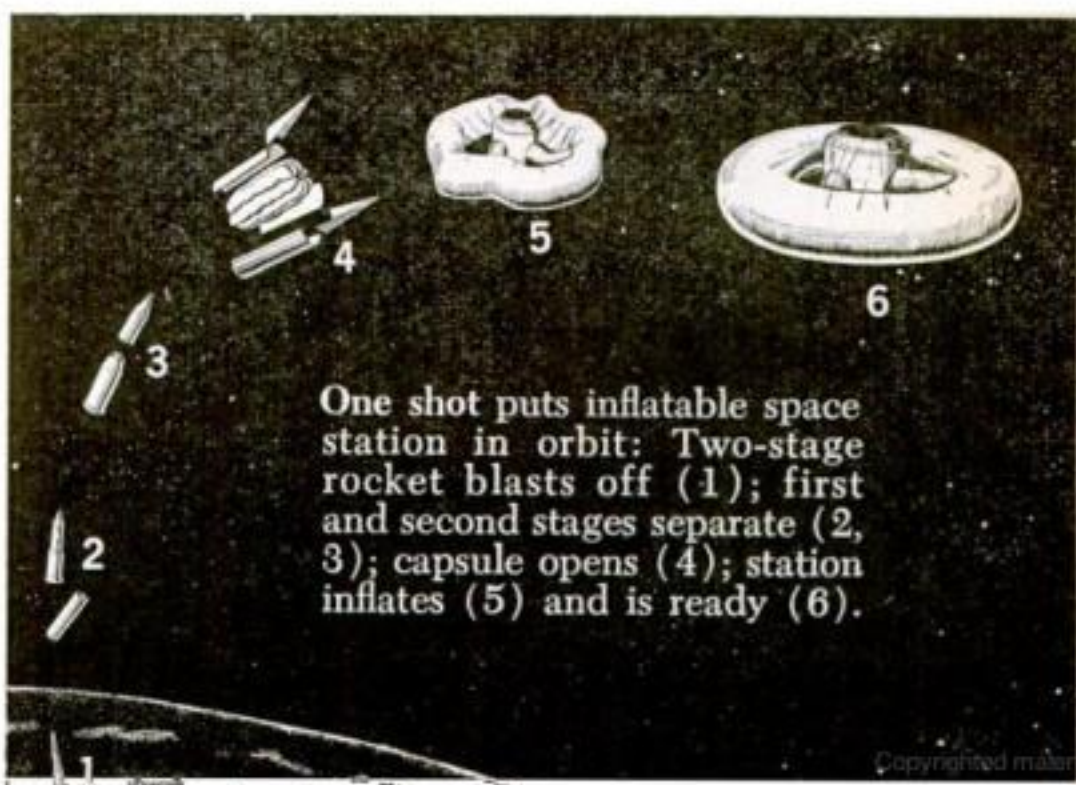
Oxygen and nitrogen tanks in the hub, after inflating the station, will maintain a normal atmosphere and permit natural breathing. “At home” in the living quarters, T-shirts and shorts will be a crew’s usual garb. A crewman will don a space suit and helmet only to go outside the station—as he might do to make an inspection or repair.

So far, the doughnut is windowless. Radio and radar will keep the crew in close touch with earth and approaching

[\[Continued on page 174\]](#)



Hazard of meteorites could be met by two-inch thickness of foam rubber, sandwiched between fabric layers of skin. Hit by 14,500-m.p.h. glass pellet, this sample resisted puncture.



One shot puts inflatable space station in orbit: Two-stage rocket blasts off (1); first and second stages separate (2, 3); capsule opens (4); station inflates (5) and is ready (6).



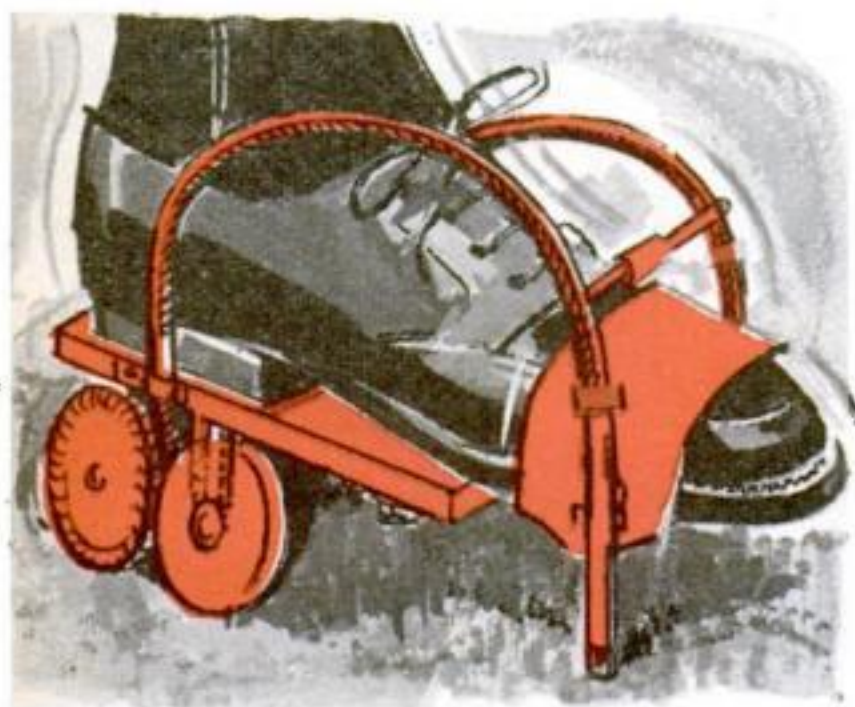


**Pin counter keeps team score.** To eliminate scoring work—and arguments—this recently patented register would signal each bowler's turn and frame, show extra balls

allowed for strikes and spares, and tally individual and team points in two alleys. Cams driven by an automatic pin setter would trigger counting switches.

# New ideas from the inventors

**"Skate" shines your shoes.** You can clean the toes of your shoes without bending or soiling your hands with this polisher. Slip a foot under the buffer, roll the "skate" back and forth, and loop-supported springs connected to the rear wheels would pull the cloth from side to side.



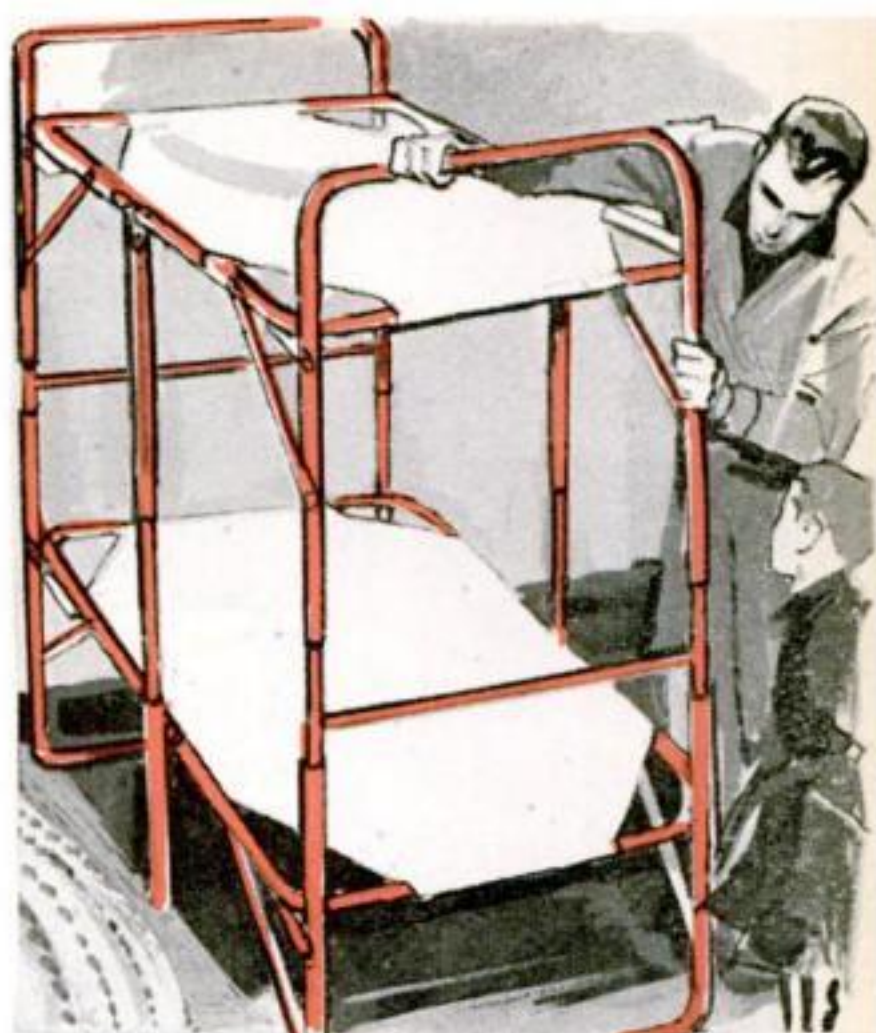
**Clock rings your phone.** Instead of phoning your morning call to the desk of a motel or hotel, you'd just set a time dial on the room phone of this Bell Labs invention. A master clock would ring you precisely at the preset hour and read you a tape-recorded wake-up message.







**Pen weighs your mail.** You could be sure your letters had the right postage if your pen had a built-in scale like this. The plunger of the retractable-tip ball point would move against a calibrated spring inside the barrel. When you clipped in a letter and held the cap, a show-through pointer would read off the weight.



**Two-deck cot knocks down.** You could fit more sleep-over guests into less space if your folding cots stacked into bunks like these. To join the cots, you'd insert coupling bars between the tubular-frame members at the center and both ends. The cots could also be used singly and would fold away in the usual way.

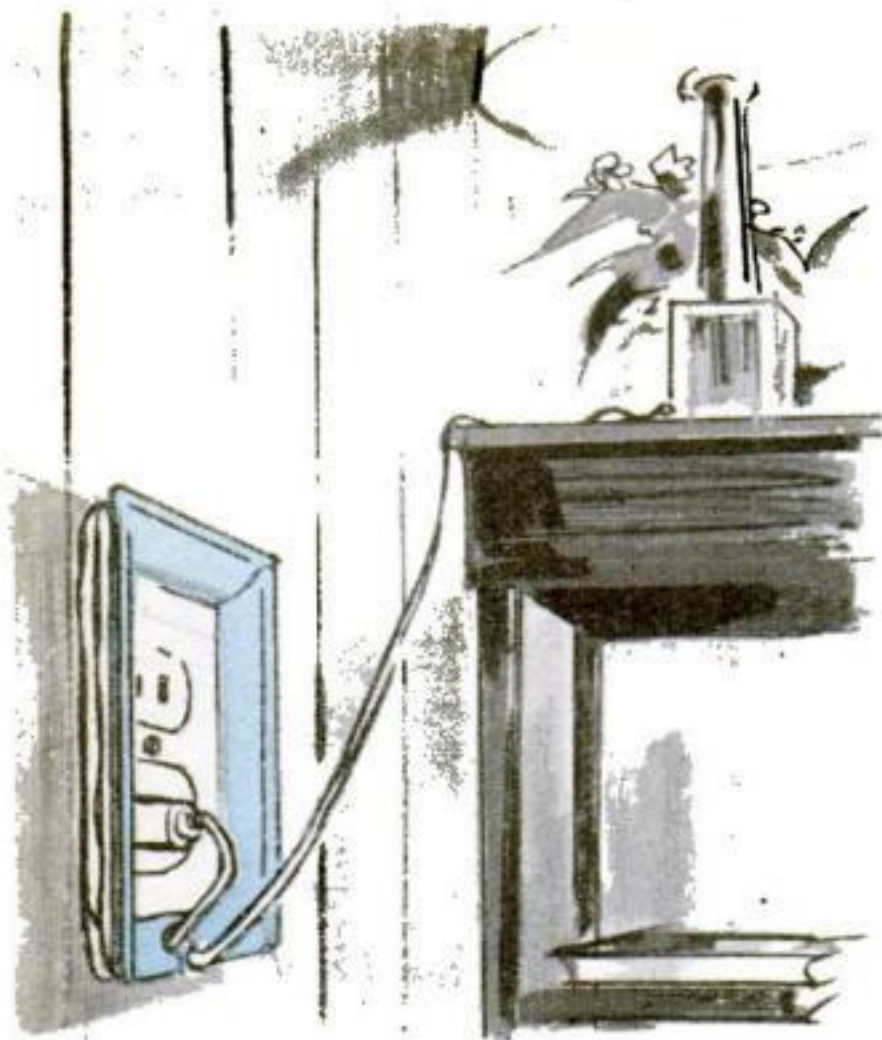
**Road signals call the turns.** Instead of relying on signs to alert fast-moving drivers to upcoming curves, stop, no-passing, or speed zones, this GM patent would use coded

ridges (or buried magnetic strips) in the roadway. A car receiver would decode the message and flash an appropriate lighted sign to tell you what's ahead.





## More inventors' ideas



**Outlet mask reels cord.** Clamped under the faceplate of an electric outlet, this tapered-rim mask would form a convenient spool on which to wind excess wire to keep it safer and neater looking. Appliance and plug ends of the wire would be brought out through a slot in the rim; flexible flaps would grip the wire in the slot.

**Trunk rack holds groceries.** Shopping bags wouldn't spill their contents around the trunk of a car if they were racked upright in this wire grid. Lifting the bags in and out would be easier, too. The rack would fold flat when it wasn't in use, or—held down by one screw—it could be easily removed when the trunk was needed.



**Hose extension flushes gutter.** You wouldn't need a ladder to clean leaves and other debris out of your gutter if you had this long-armed extension coupled to your garden hose. A scraper foot on the curved upper end would loosen clutter.

The following patents have been issued on these inventions: **Scorer**—No. 3,043,593 to J. C. Koci, Barrington, Ill.; **Shoe shiner**—No. 3,041,646 to O. M. Dyer Jr., Detroit; **Phone Clock**—No. 3,046,339 to C. Breen et al., Mineola, N.Y.; **Scale**—No. 3,043,387 to Z. Nachsi, 630 Bedford Ave., Brooklyn, N.Y.; **Cots**—No. 3,037,213 to E. Anderegg, Green Bay, Wis.; **Signal**—No. 3,044,043 to F. S. Wendt, Birmingham, Mich.; **Reel**—No. 3,042,739 to B. M. Craig, Pasadena; **Rack**—No. 3,043,441 to J. Dumford, 7969 Kenwood Rd., Cincinnati; **Gutter cleaner**—No. 3,041,655 to W. Entler, 518 NW Hoyt, Portland, Ore.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.



# The Ship That's Built to Sink

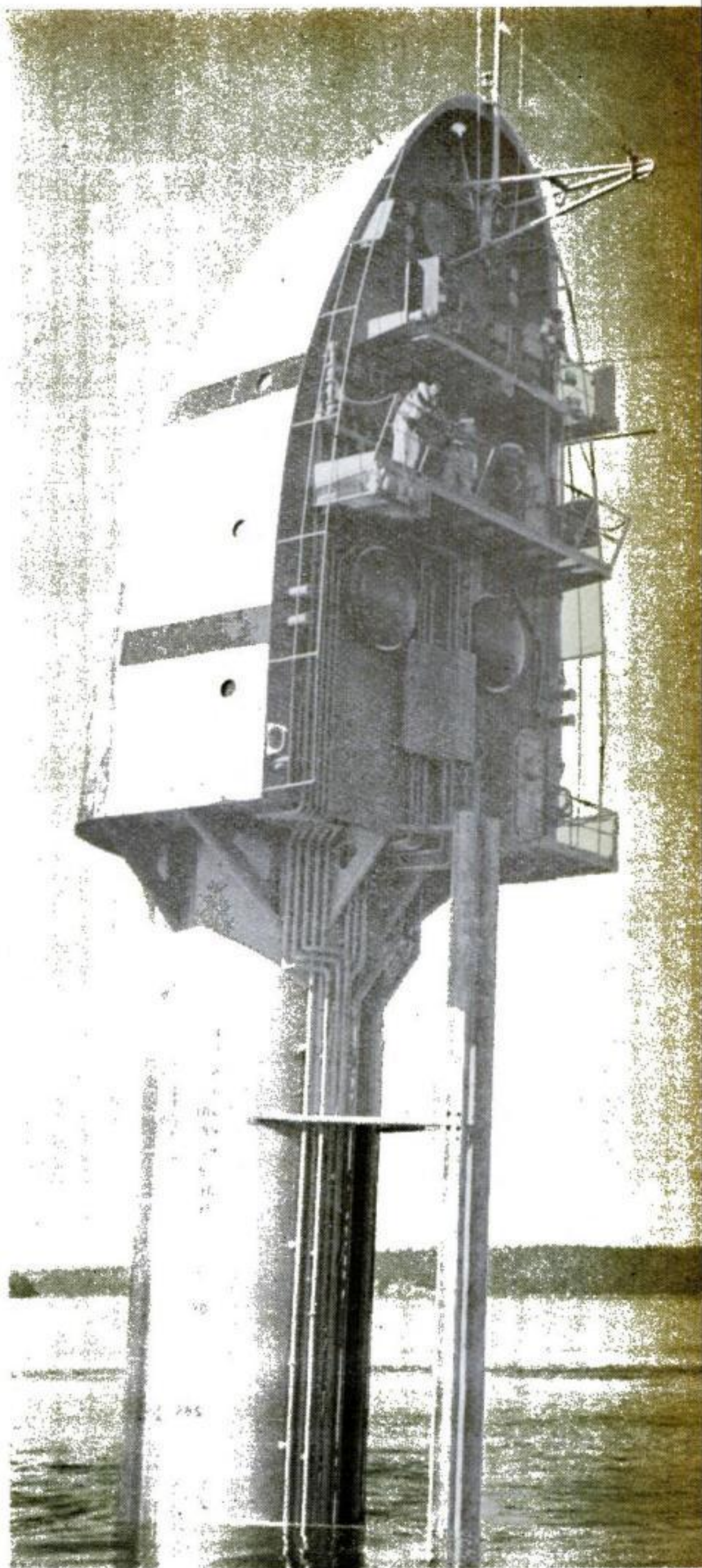
Flip is its name, and flip it does—to work standing upright on its tail

By Wesley S. Griswold

**I**T'S the craziest-looking vessel I ever did see. You couldn't really call it a ship—though it will travel thousands of miles at sea. It has a fairly orthodox (though rounded) prow—but its hull is a huge steel tube. It's 355 feet long and weighs 600 tons—but it can't budge itself. It has to be towed wherever it goes. It isn't a barge, though.

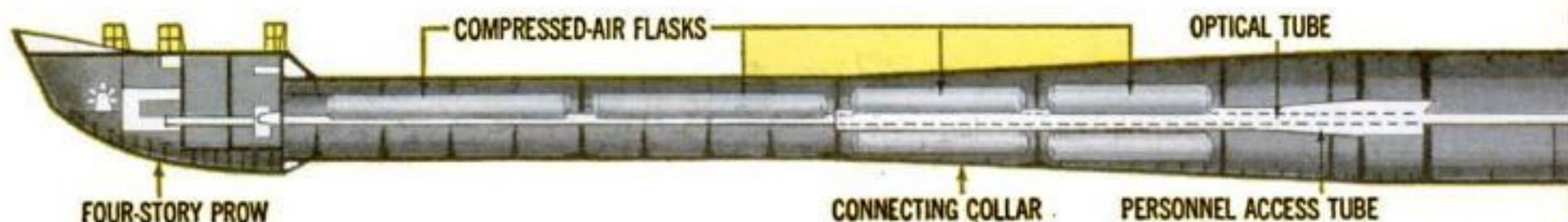
If you could set it on its blunt, circular stern on land, it would stand as tall as a 35-story building. Viewed from above when it is lying full length in the water, like a proper boat, it resembles an immense stalk of asparagus, painted gray. When it's be-

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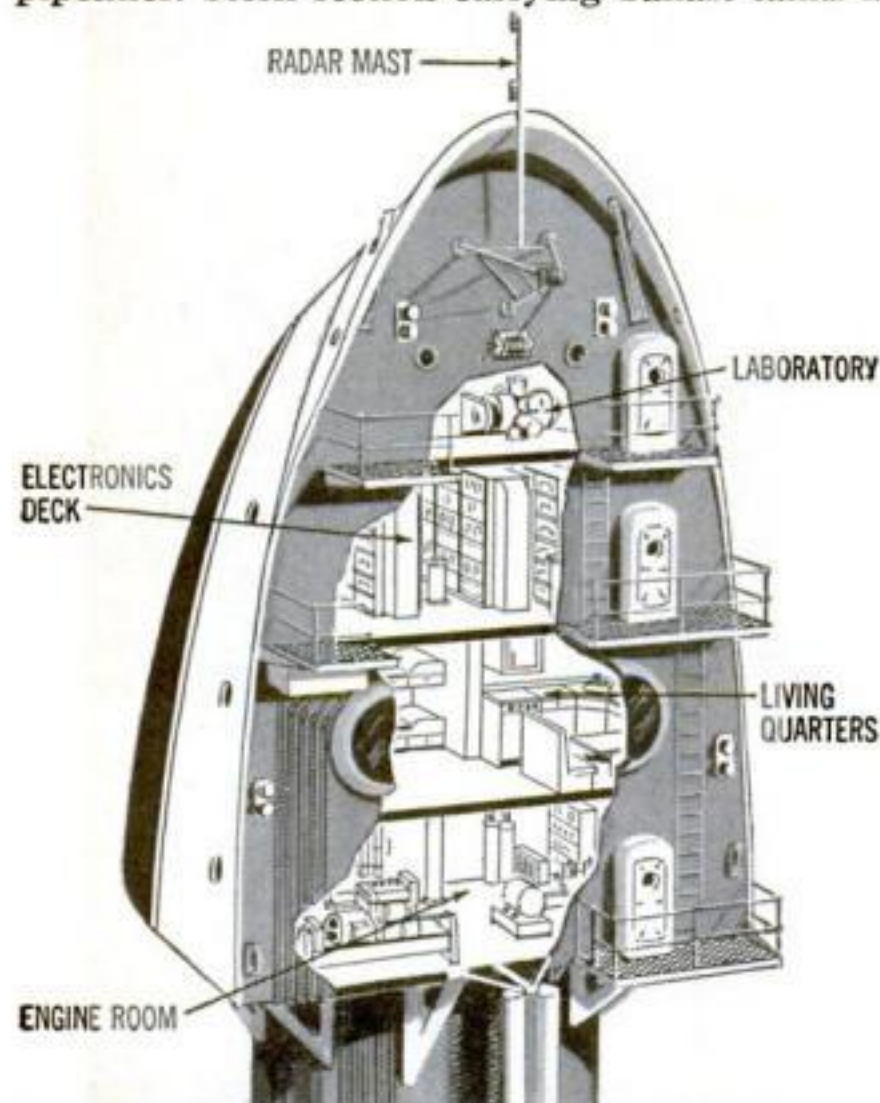


On even keel and under tow, Flip looks almost like a normal ship; then she floods her stern to study the ocean 300 feet down



Long tubular hull looks like two huge welded pipelines. Stern section carrying ballast tanks is

150 feet long and 20 feet in diameter. It's connected to prow by a 12½-foot tube.

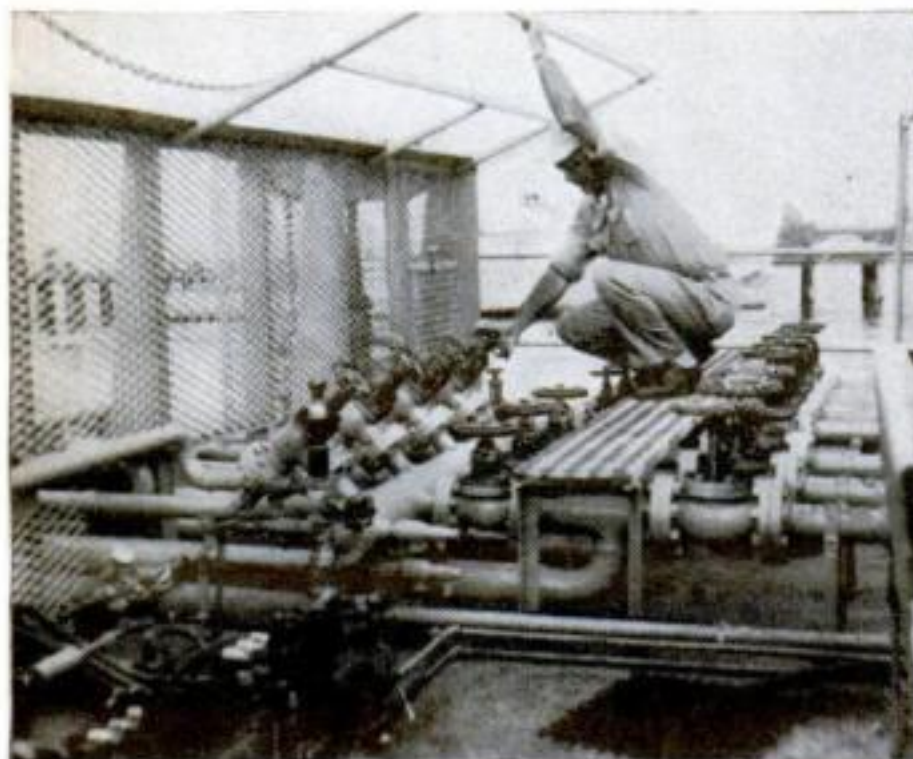


Cutaway drawing shows interior of four-story cabins. Generators on gimbals remain level.

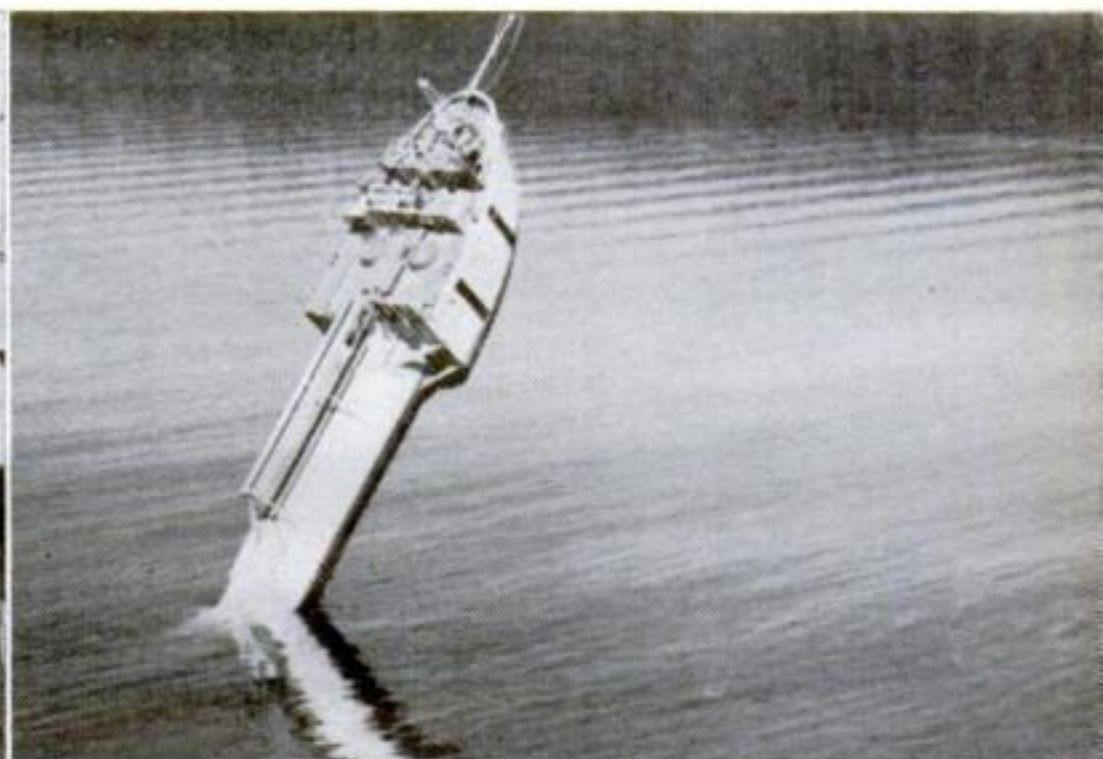
having like a proper boat, however, it isn't at all proper below deck. It's like a house tipped on its side. Many a fixture that should be horizontal is vertical.

This is "Flip." And flip it does. And so would you if you came across it at sea when it's on duty, as it is expected to be this month. For the chief purpose of Flip, a remarkable and important new scientific vessel, is to stand on its rear end, with 300 of its 355 feet submerged. In that position, it has the deepest draft of any craft in the world. It'll ride the waves like a sedate buoy, so stably that it will rise and fall less than three feet in a 30-foot swell. And then, at last, everything inside will be right side up.

Flip gets its name from FLoating Instrument Platform, which is what it is. It's loaded with electronic gear—hydrophones, radar, microwave apparatus, ra-

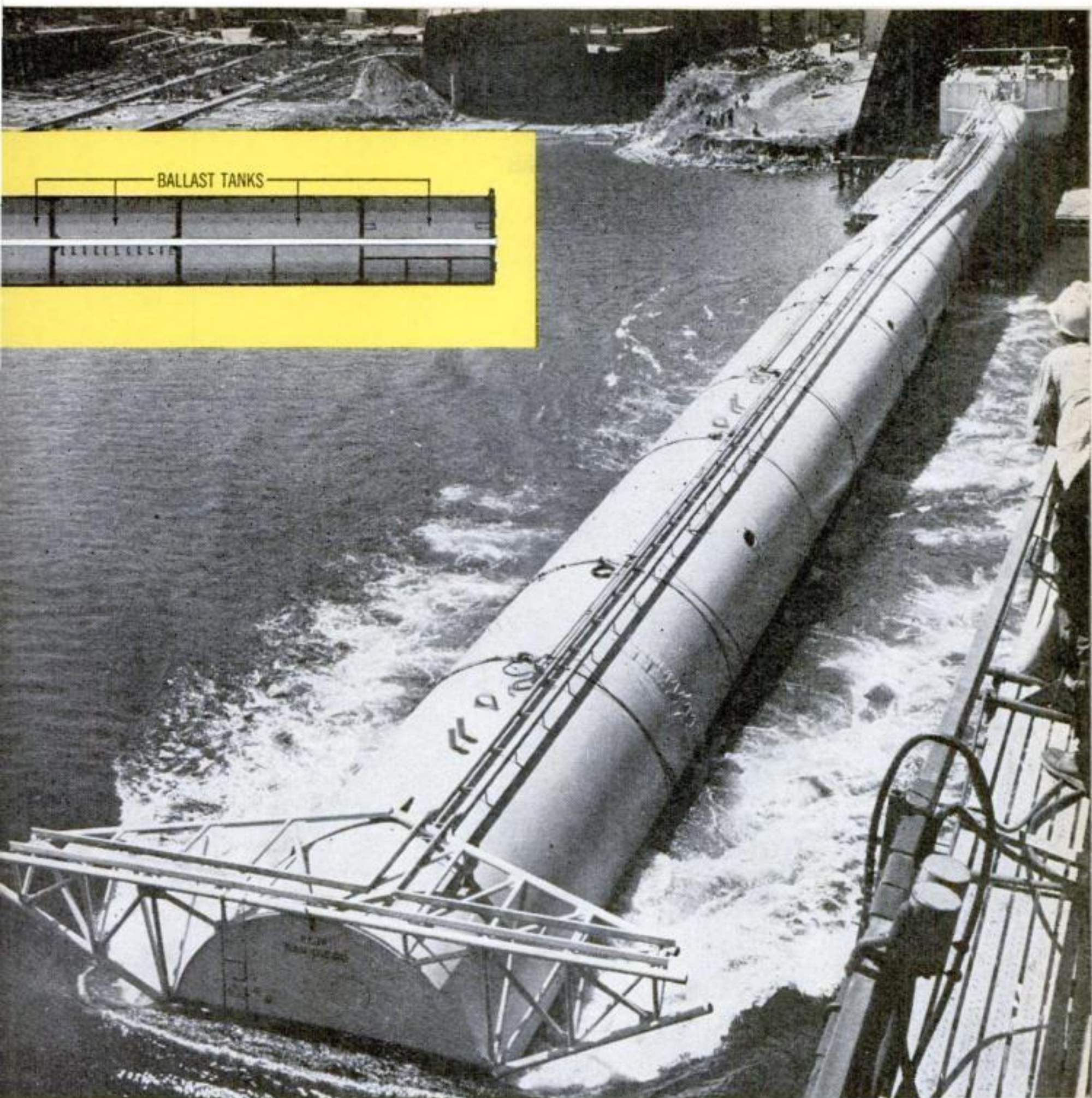


Control platform (horizontal view) contains maze of pipes and valves for flooding tanks.



In process of flipping, ship sticks prow up out of water as stern ballast tanks are flooded.





Outrigger at stern is 50-foot hydrophone that will listen for sounds 300 feet below surface.

radio, tape recorders, oscilloscopes—and it belongs to the U. S. Navy. The University of California's Marine Physical Laboratory will operate it for the Navy.

This grotesque vessel's first mission has the highest priority. It is to study the behavior of sound waves underneath the Pacific. Later it will investigate wave motion, inner waves, and marine biology.

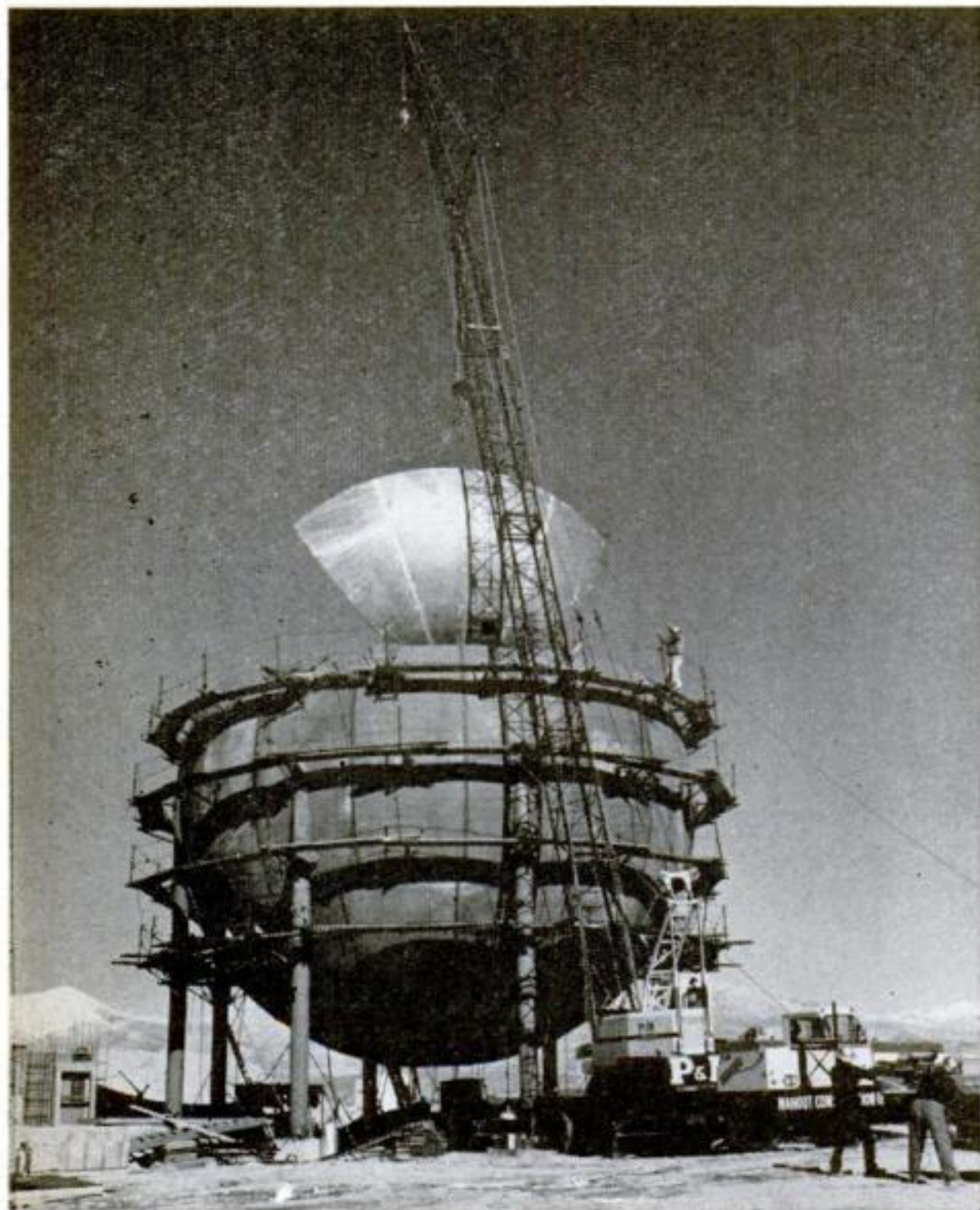
**Submarine attack** is one of the sharpest menaces this nation would face in wartime. Antisubmarine forces need to be able to detect, identify, and pinpoint

sources of sound underwater. Unfortunately for them, layers of ocean vary in saltiness and temperature, direction and speed. All these factors play hob with sound waves. By finding out more about sound waves, the four scientists who will bob up and down on Flip may help give our antisub forces keener ears.

I went aboard Flip at San Diego, where she had been towed from her builder's berth at Portland, Ore. Only her low prow was visible at first from the wharf.

*[Continued on page 178]*





## Tank keeps hot fuel real cool

A huge 1½-inch-thick section of aluminum, part of a 65-ton ball, is lowered at right by a crane into its steel-ball casing.

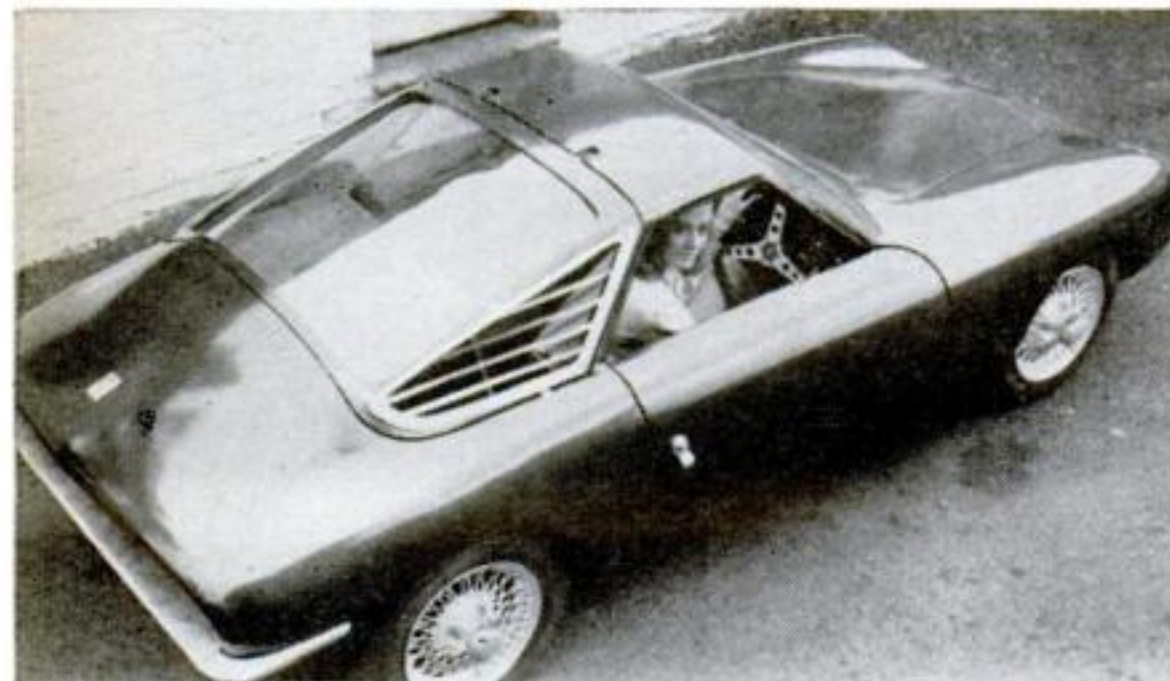
Once in place, the piece was welded to adjoining sections by a new, speedy, Kaiser-developed process. Then insulation was blown into the space between the balls.

The 40-foot-diameter cryogenic tank was built at Jackass Flats, Nev., to store liquid-hydrogen fuel at minus 423 degrees. The fuel will be used in Project Rover—research aimed at developing a nuclear engine for spacecraft propulsion.

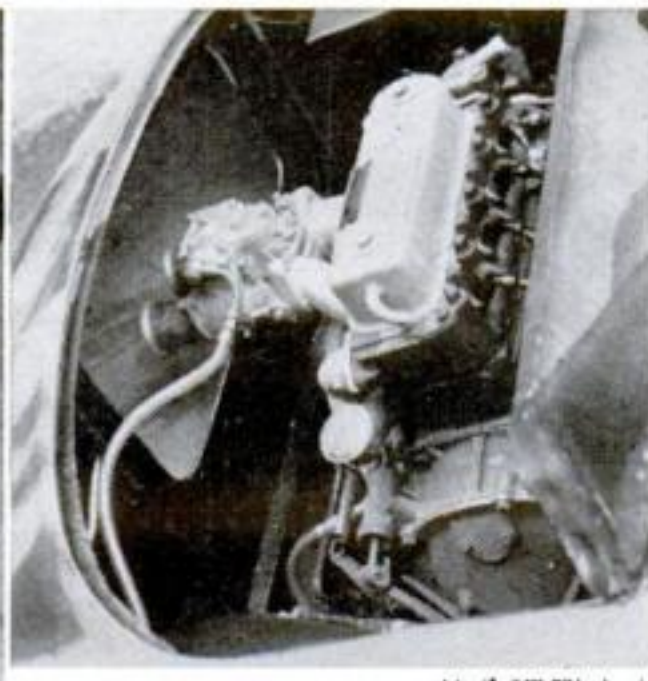
## Rear-engine Mini-GT

The British answer to Italy's midget Grand Touring cars is the Gitane 1000, an aluminum-bodied two-seater capable of 135

m.p.h. Disk brakes all around give powerful, nonfade stopping. The car is built on a tubular space frame. Lush interior trim includes rubber-backed pile carpeting and leather (roof) headliner.



Barely a yard high, the car has an overall length of 11 feet, 4 inches. Louvers behind the cockpit gulp air for engine cooling.



Lifting the rear window gives access to the transversely mounted B.M.C. Mini-Cooper engine, an 83-hp., 60-cu.-in. in-line four.

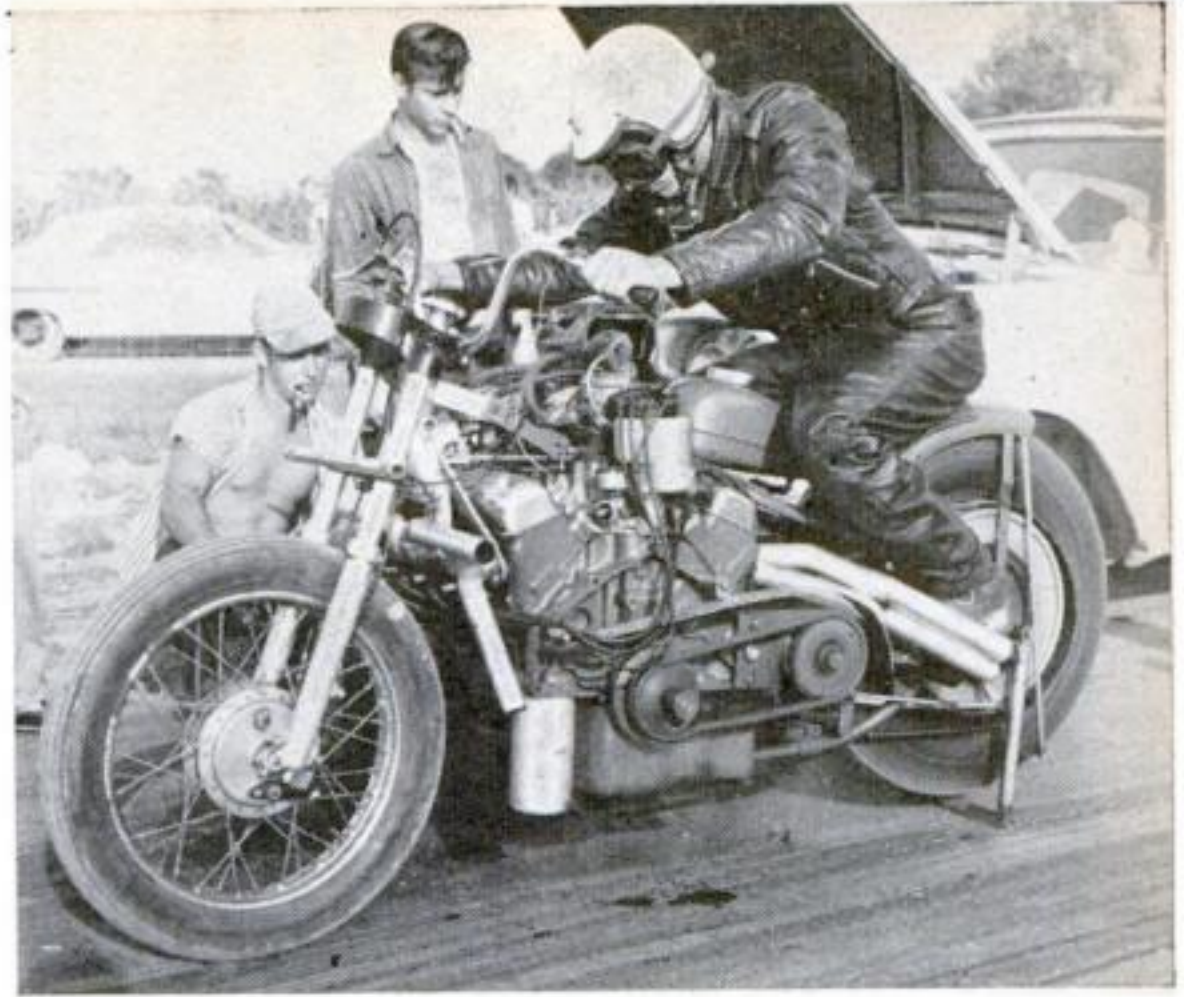




### Flexible pipeline is laid under water

This new flexible pipe is designed to carry either liquids or gases across rivers or to offshore islands. It's armored and asphalt coated on the outside, lined with polyethylene on the inside to prevent contamination. Inside diameter is two inches.

Its big advantage, says Simplex Wire and Cable Co., is ease of installation and cheap maintenance. It can be floated on buoys (as above over the 1,400-foot-wide Hampton River at Hampton Harbor, N. H.), then sunk to the bottom by cutting the buoys loose. Being flexible, it gives with the tides without strain.

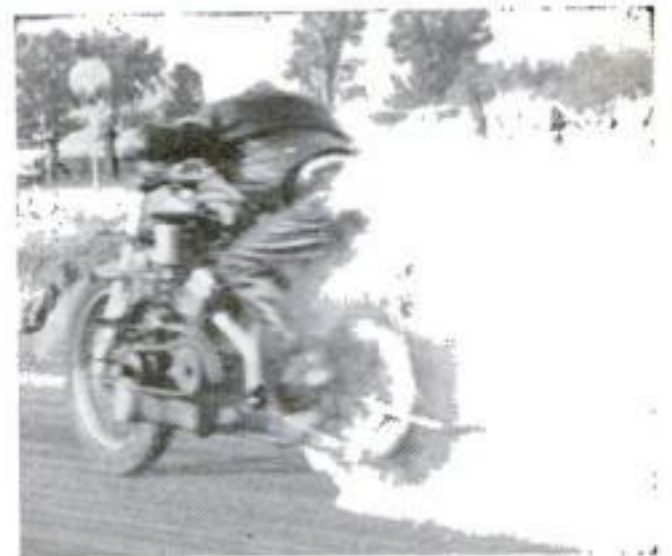


Drive is through chains without clutch or transmission. Aircraft starter turns over engines while rear wheel is on stand.

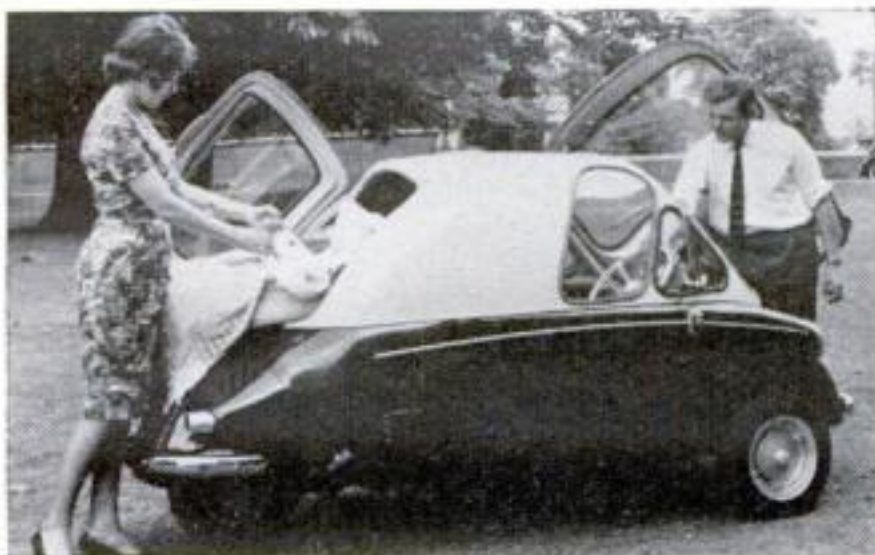
### Auto engine powers motorcycle

Installing a Chevrolet V-8 in a Harley-Davidson won't give you a machine that's ideal for taking your girl out on Sundays. But at drag strips, the motorcycle posts 140 m.p.h. in 10 seconds in the standing-start quarter-mile.

The 1960 power plant serves as part of the frame structure. It has a quarter-inch overbore, special camshaft, and magneto ignition. A front fork from an Indian motorcycle gives dual front brakes. The drive chain is replaced every six weeks to prevent a break. E. J. Potter of Ithaca, Mich., is the owner.



When rider is ready, he kicks out stand and is off in cloud of burned rubber. Leather outfit is safeguard in case of a spill.



### Baby or luggage rides in back

Baby goes through the back door in the Trojan bubble wagon, which seats two adults in front. The rear compartment can take a five-cubic-foot load, making the English machine suitable for a midget delivery van. Beneath the wooden floor is a tiny 12-cubic-inch, four-stroke engine driving through a four-speed gearbox to a single or double (optional) rear wheel. Cruising at 45 m.p.h., it gets 95 miles from a gallon of gas.



# A Photography Gift for Christmas?

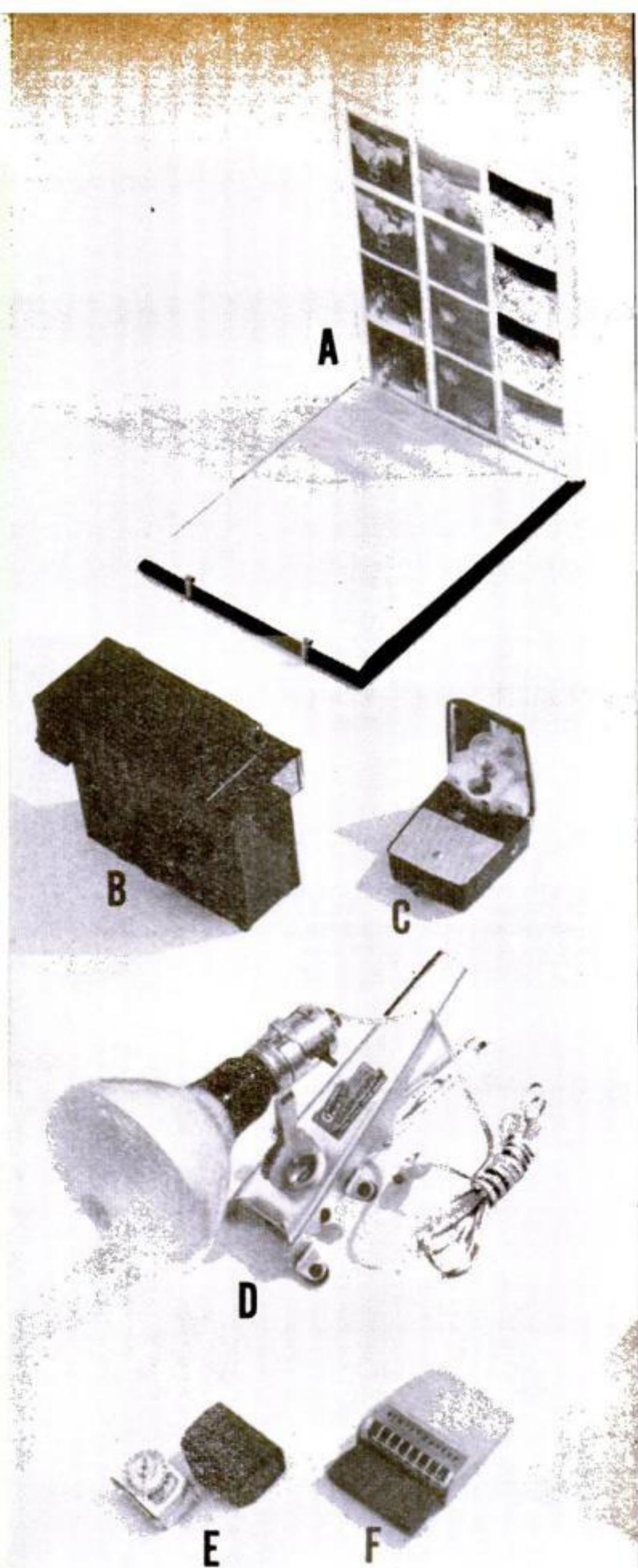
What would you like? Here's a handy list to leave around the house—as a guide for others

By Bob Hering

**A**RE you a 35mm fan or strictly a movie man? Whatever your photo interests, there are plenty of products to make picture taking easier. Knowing how difficult it is to ferret out a perfect gift—for someone else or yourself—we went shopping to see what we could turn up.

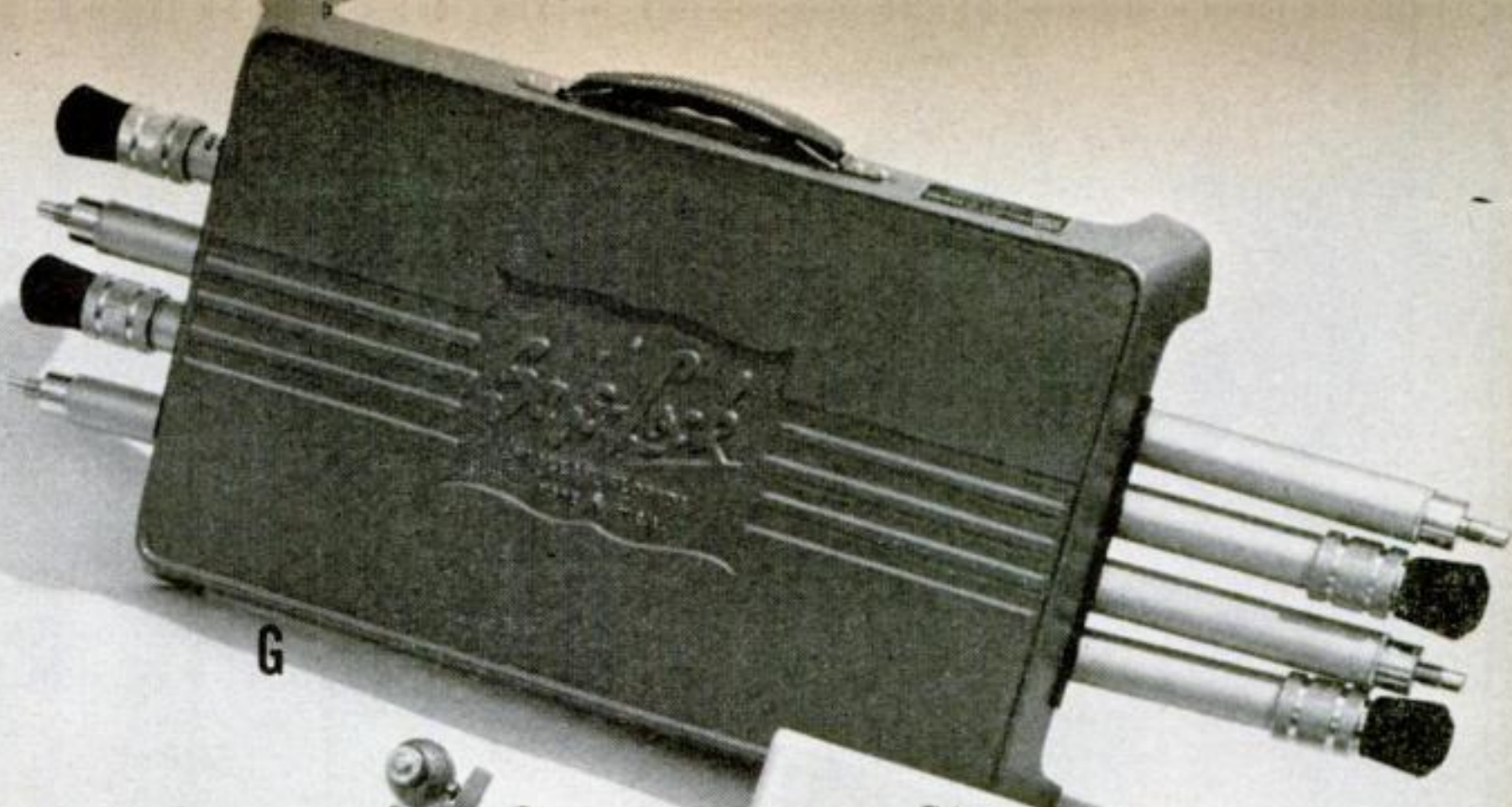
No photographer ever owns all the equipment he needs—there's always at least "just one more" thing. Our selection includes gadgets a camera fan would like but simply hesitates to buy for himself. Still, they're inexpensive enough to be included in even a slim budget. Look them over—and check off a couple that you'd like if you were on the receiving end.

**A. Strip-film proofer.** You can speed up darkroom work with a proofing frame. Just be sure to get one that handles the negative size you're using. With the Mioplex strip printer, you can print three four-frame strips of 120 negatives on a sheet of 8"-by-10" paper. The 120 model is \$11.95.

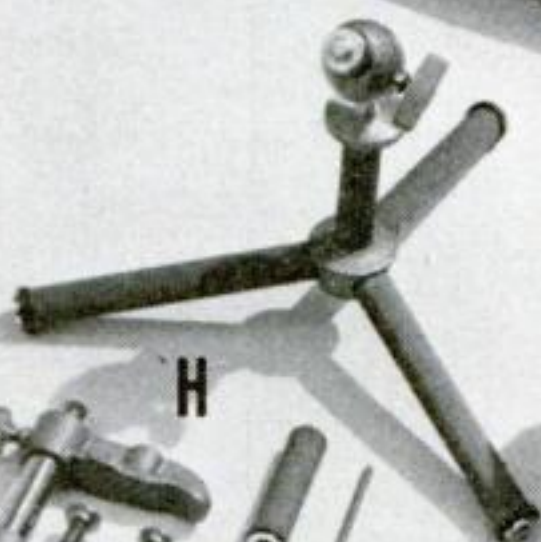


- |                             |                     |
|-----------------------------|---------------------|
| A. Strip-film proofer       | G. Projector table  |
| B. Daylight developing tank | H. Table-top tripod |
| C. Remote flash unit        | I. Slide sorter     |
| D. Gator Grip               | J. Slide cabinet    |
| E. Exposure meter           | K. Unipod           |
| F. Staticmaster brush       | L. Monocular        |
| M. Movie viewer             |                     |

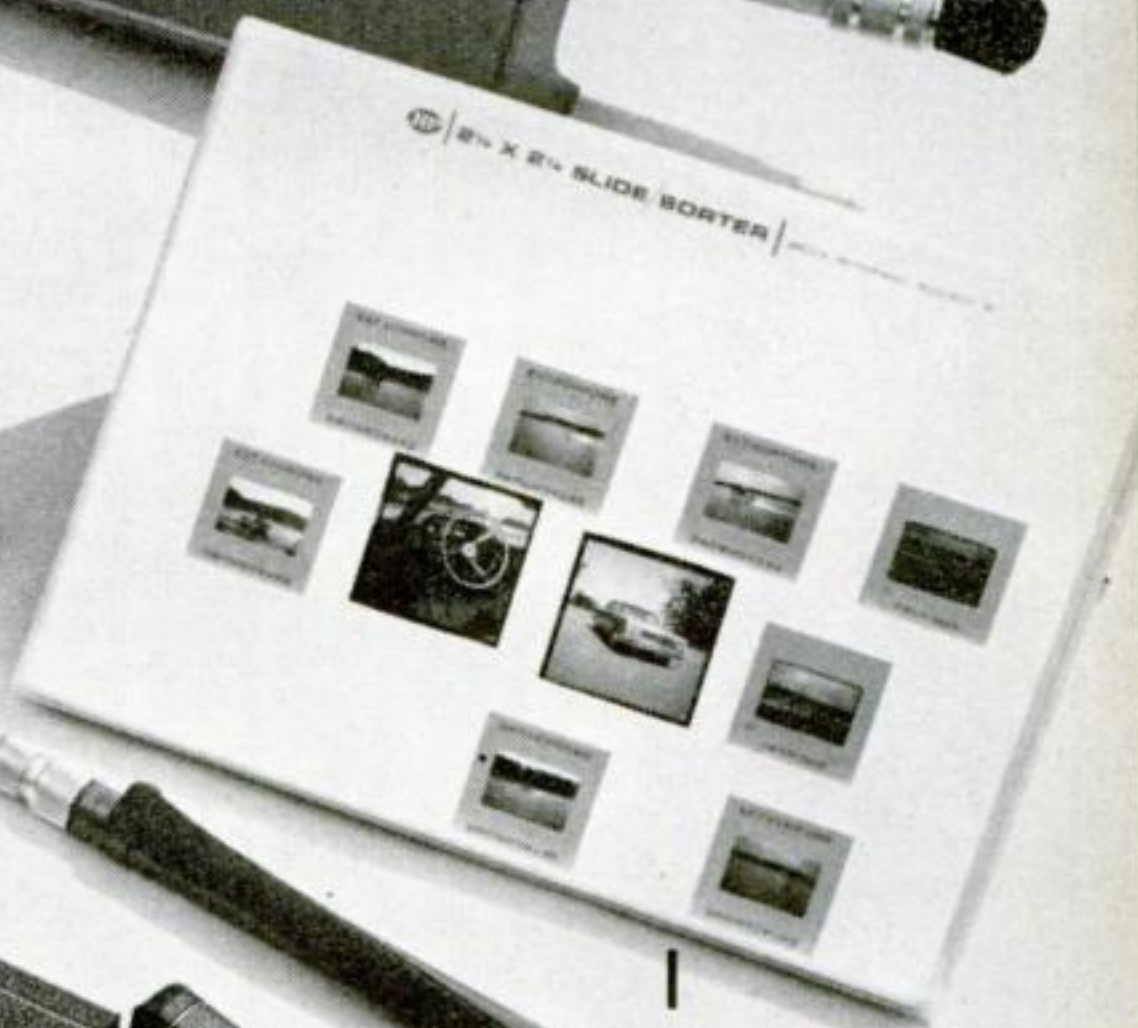




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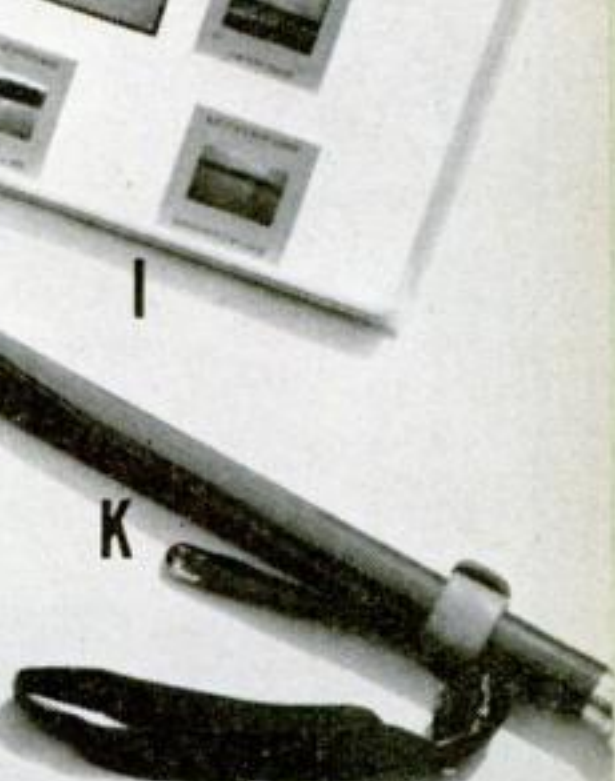
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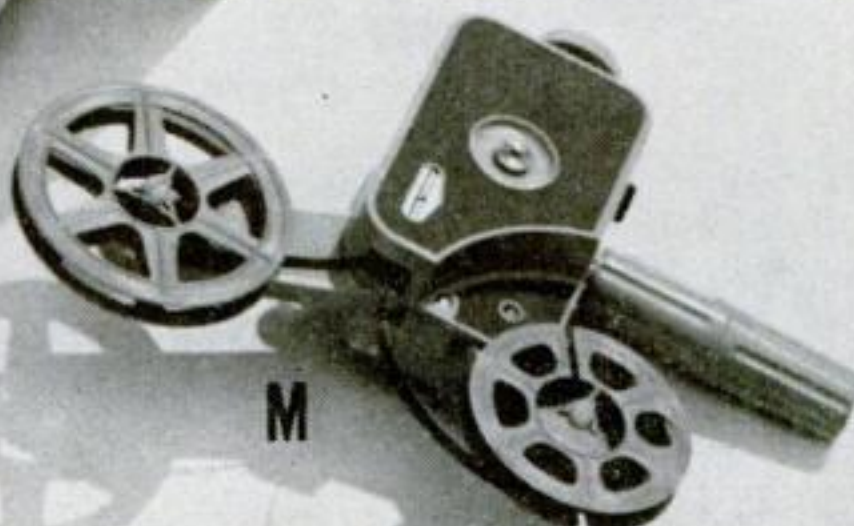
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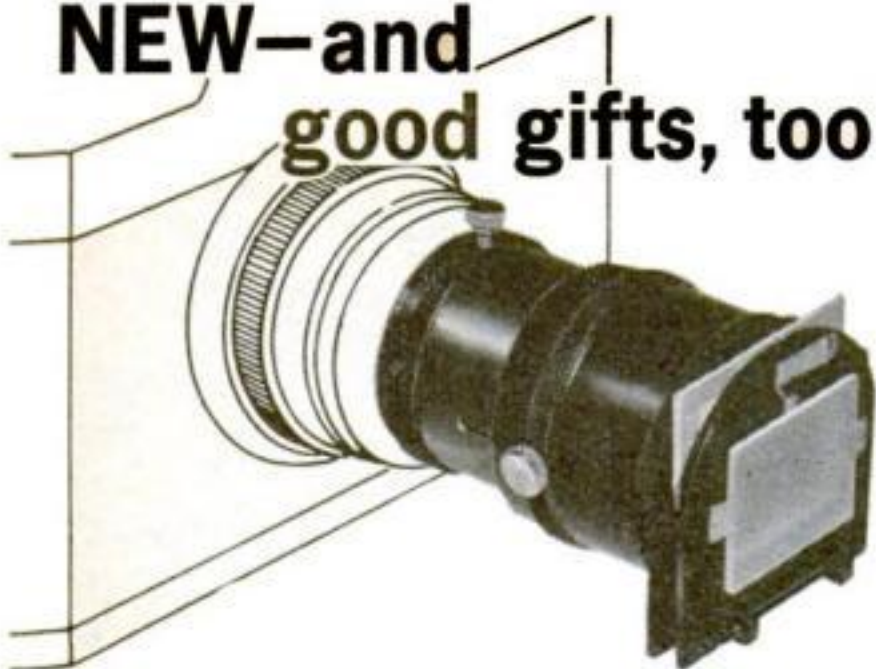
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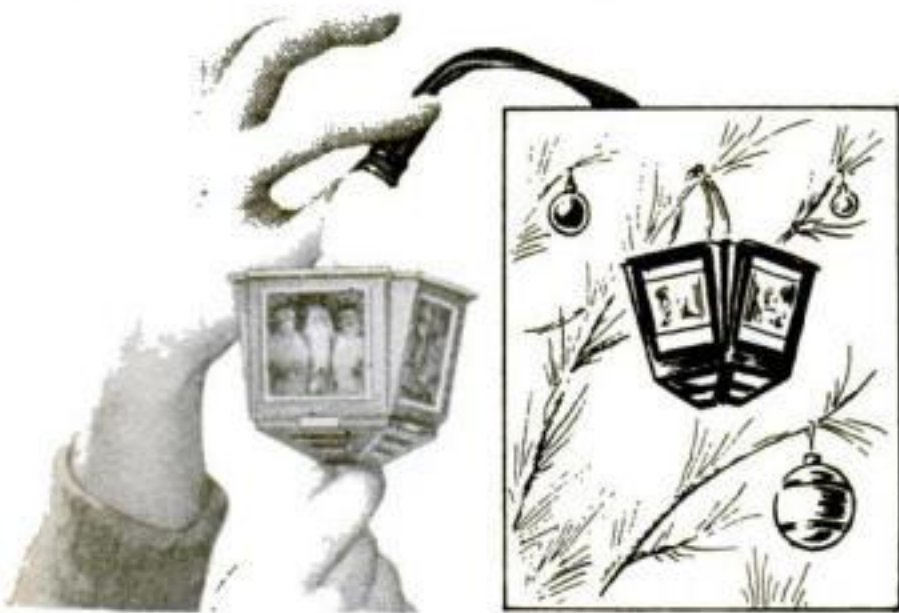
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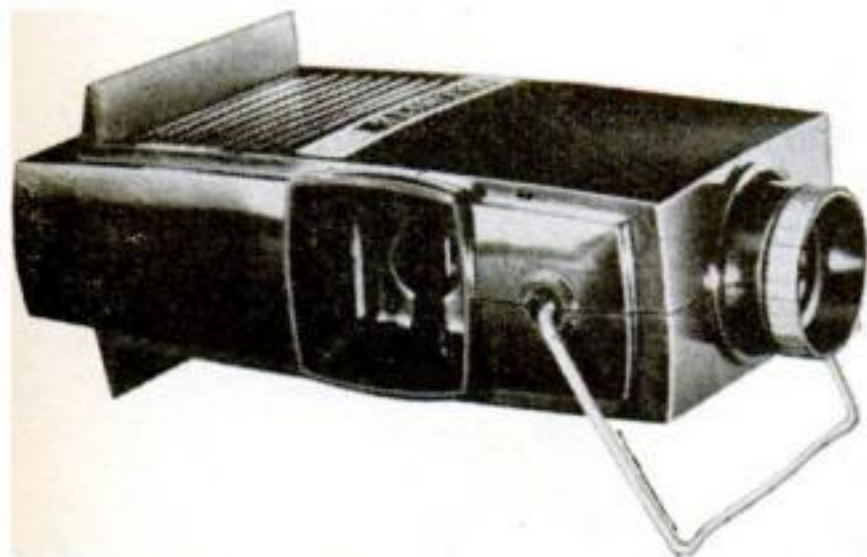
## NEW—and good gifts, too



**Newest slide duplicator** includes adjustable dual tubes to vary the degree of magnification. It fits any lens using a series VI or VII adapter ring. Besides duplicating slides, you can make positives from negatives and do similar copying. \$19.95. Photographic Importing and Distributing Corp., 708 Byron Ave., NYC.



**For something new in decorating**, hang your color slides on a Christmas tree. Displayed in a plastic Lan-O-Turn viewer, slides of family and friends will become the conversation piece of the holidays. Each viewer holds four slides. It revolves by hand for convenient viewing. Price is \$1. Chapiewsky's, Bangor, Wis.



**Compact slide projector** is priced low enough to be included even on an economy-budget Christmas list. It is manually operated, with each slide ejecting the previous one. The Balmite 50 projects a 40"-by-40" image from 9½". The price is \$15 and Bausch & Lomb, Inc., Rochester 2, N.Y., makes it.

**B. Daylight developing tank.** If you're a 35mm fan who enjoys doing your own dark-room work, this is sure to take your fancy. It's one of those deluxe outfits that just misses including the kitchen sink. You can load the tank in daylight. A frame-counting device shows how much film is loaded, and there's a built-in film cutter to snip off part of a roll. There's even a built-in thermometer to keep track of the temperatures of the developing solutions. The Leitz Rondinax sells for \$24.

**C. Remote flash unit.** This is one of our favorites. Once you learn what you can do with one of these compact slave guns, we're sure you'll be back hinting for a couple more next year. If you already own a flash gun, then a slave unit is just the ticket. It's small enough to slip in your pocket, weighs only 5½ ounces with batteries, and there's no bother with extension cords or other hook-ups. You flip open the cover and insert a flash bulb. An electric eye triggers it to fire simultaneously with the flash on the camera. You can hand-hold the unit or, using one of the two sockets, mount it on a stand, clamp, or tripod. An Eastman product, it sells for about \$20.

**D. Gator Grip.** Any photographer who works with floods and spots in restricted areas at home knows how difficult it is to arrange regular light stands. With a compact Gator Grip it's easy to mount the floods, spotlights, and other accessories to either round objects or flat ones. Cost: \$3.40.

**E. Exposure meter.** Probably you already own a good exposure meter but often wish you could leave it home when you want to travel light. Then here's a suggestion you'll like. This compact Alpex meter measures reflected light on high- and low-range scales. It has a shoe that fits all cameras using standard accessory clips. Some of our friends are so glad to own a clip-on meter that they soon leave their regular meters behind. List price is \$9.95.

**F. Staticmaster brush** is a gift any photographer will like. The brush cleans by neutralizing the static charge in dust particles so the bristles can sweep them away. One model has a replaceable cartridge and is available in several sizes. The 1" model sells for \$4.95, the 3" for \$9.95.

**G. Projector table.** Any cameraman knows how tough it sometimes is to locate a sturdy table of the right height for projecting slides or movies. This gift will make



the whole family happy. The Project-O-Stand adjusts up to a height of 56". Best of all, the legs are removable. It's made of aluminum and equipped with a molded handle. Price: \$39.75.

**H. Table-top tripod.** If you're a gadget lover, the Rowi universal combination stand is sure to please. Basically, it's a small table-top tripod with a swivel head. But this 22-piece set will make just about any type of camera or accessory support you can dream up. Each part in the kit combines with the others. The clamping unit fastens to supports as thick as three inches. Even a tree screw is included. The kit, complete, sells for \$15.95.

**I. Slide sorter.** Are you a color-slide fan? Then you'll go for an HPI slide sorter. It's a viewing box with five steps to hold 35mm and 2¼-by-2¼ transparencies. You can edit and sort up to 40 2-by-2 slides at a time on the translucent tiers. The price tag is a modest \$4.95.

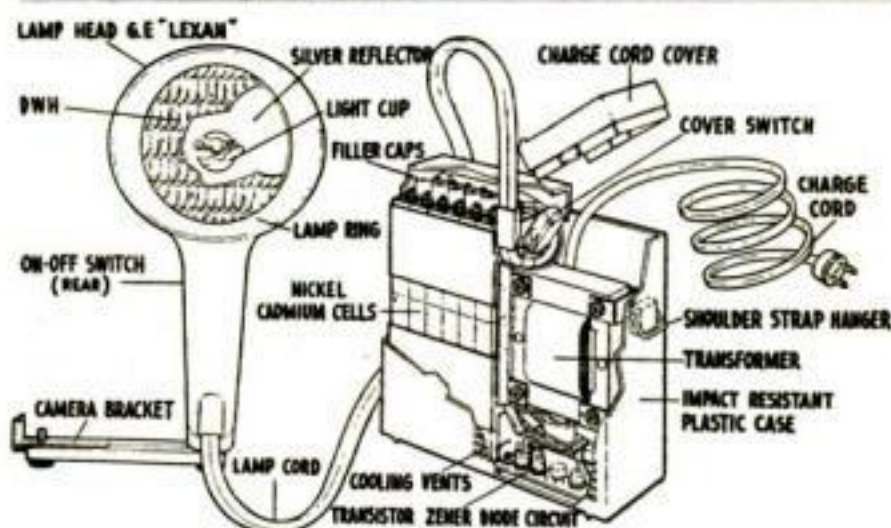
**J. Slide cabinet.** If you've been keeping your slides in their original mailing cartons, then the Baja slide cabinet would be a welcome gift. It holds 300 2-by-2 glass slides or 900 ready-mounts. Price is \$13.95. The cabinet is dustproof and has removable index cards for recording contents.

**K. Unipod.** As even the huskiest camera buff will admit, a tripod has a way of becoming a three-legged monster after you've lugged it around a few hours. To help you solve the weight problem, here's a Whitehall Sportpod (Quick-Set). It extends to 58", telescopes to 21½". Price: \$5.95.

**L. Monocular.** If you're a sports or nature lover who is also interested in photography, we suggest a compact monocular. It converts a normal lens to a telephoto system. The Accura 6-by-30 fits series V and VI adapters. It's the best way to obtain maximum image size at a minimum price. With a 50mm lens on a camera, the monocular changes the combination to an effective 300mm at f/10. It lists at \$29.95.

**M. Movie viewer.** For movie buffs, we located a handy item called a Cine Viewer. With it, you can preview 8mm movie rolls (up to 200-foot capacity) without bulky equipment. You load it like a projector, look through an adjustable eyepiece, and crank the film through as fast or slow as you wish—even run it backwards. Included are two pen-light batteries that power the viewing light, so it's possible to view films anywhere. Cost: \$9.95. ■ ■

## NEW—and good gifts, too



Portable movie light, powered by a rechargeable nickel-cadmium battery, provides the movie fan with a compact light source for shooting color indoors. Price: about \$125. Made by GE.

Viewing cabinet lets you project slides even in a bright room. A clear 9"-by-9" image appears on the Mirascreen. Legs and optical system retract. \$39.75. Sawyer's, Portland 7, Ore.



Automatic 8mm movie camera includes electric exposure system and motor, f/1.8 zoom lens, through-lens reflex viewing for \$90. Yashica, Woodside, N.Y.





## Test report on the Flying Scott 17.D.75

# You Name It: This Boat's Got It!

By Jim Roe

*Jim Roe, Popular Science's new boating editor, is a man who likes wind in his face and spray alongside, an inclination in which he is ably seconded by his son Jim—as you can see in the photo at left. The photo was taken as the two Roes made a test turn in the Scott 17.D.75, which has made so much news during the past season. The report that follows is the first of a series of first-hand boat and motor tests by Jim Roe.*

**I**F SOMEONE installed stereo hi-fi in the Flying Scott 17.D.75, it could truly be described as the boat that has everything. I'm convinced her designers asked a brain-storming session of boatmen and engineers for ideas they'd like to see in a boat—and then used every one. However they did it, the result is a happy combination of factory-matched boat and motor.

Our test boat was a 17-foot day cruiser, powered by the 75-horse Flying Scott engine. It's sold as a package—with steering, lights, controls, gas tanks, and instruments factory-installed.

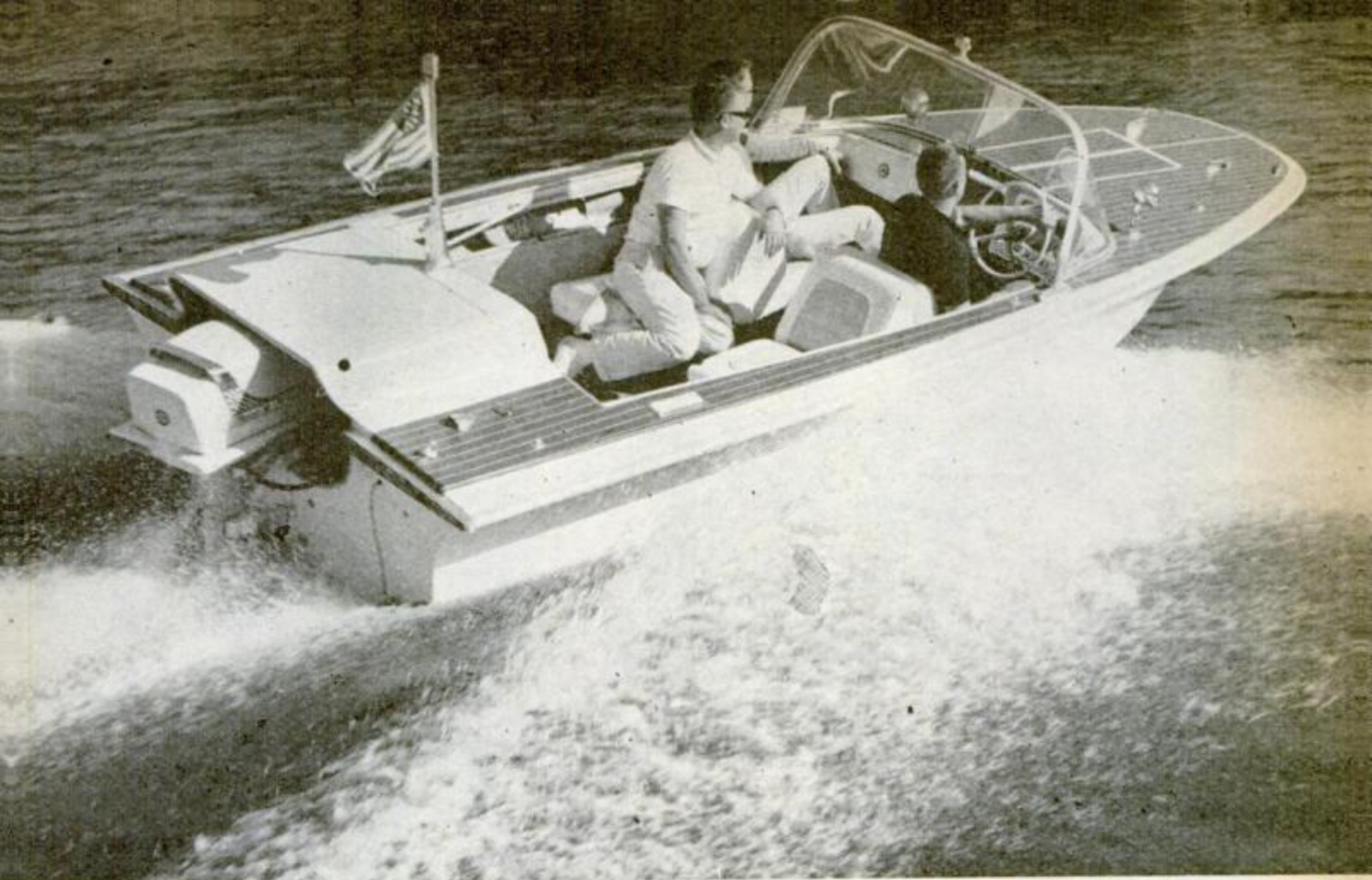
To put our boat through her paces, we launched her in the Fox River west of Chicago. It's a waterway typical of inland

CONTINUED

Launching proved to be satisfyingly easy. Boat rides on a specially designed trailer, well balanced and with ample frame strength.



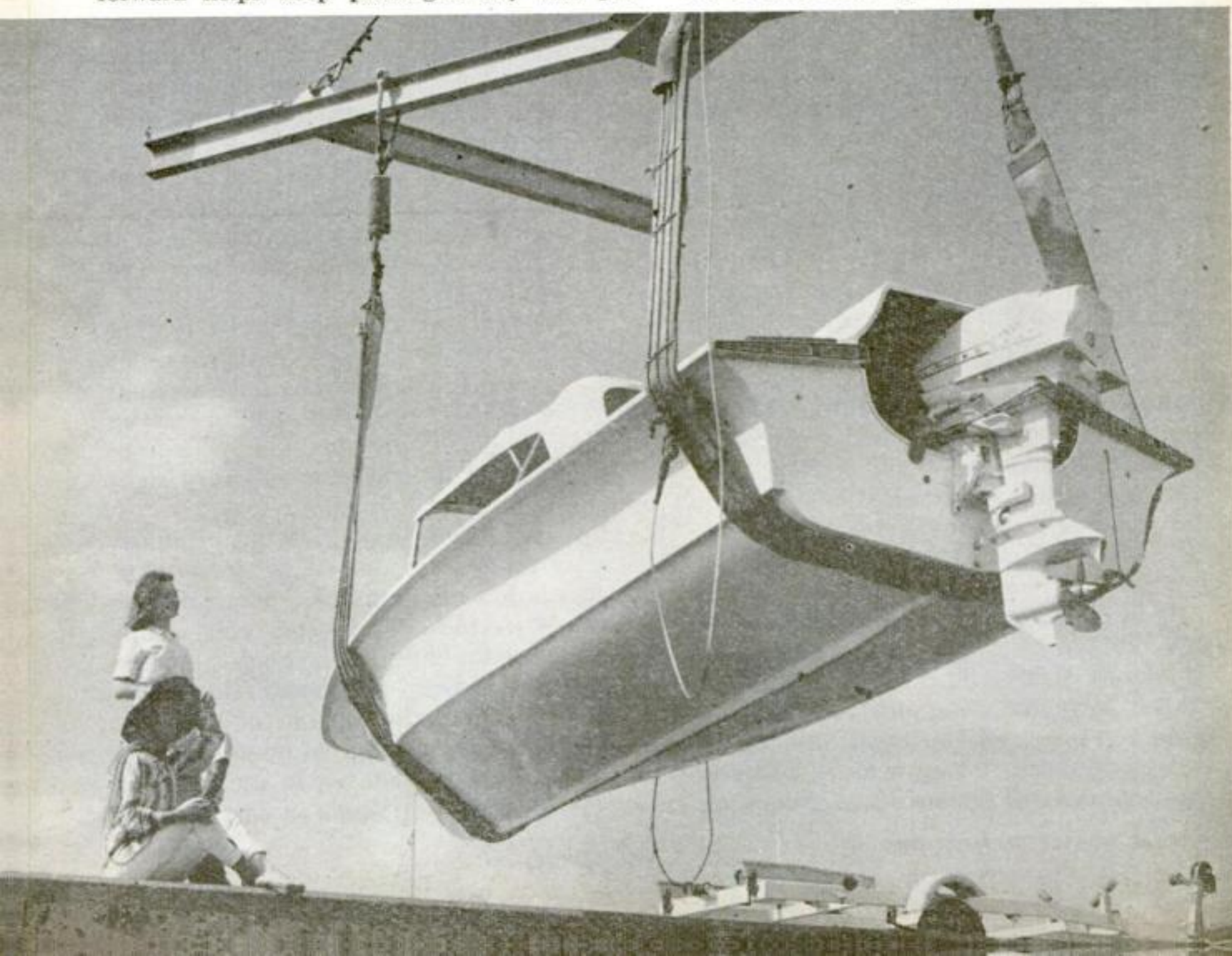




Tight turns are great fun. There's a minimum of sideslip, and control is easy all through the turn.

From below, you can see that the fiber-glass hull is basically a deep-V style. That wide flare forward helps keep passengers dry and pro-

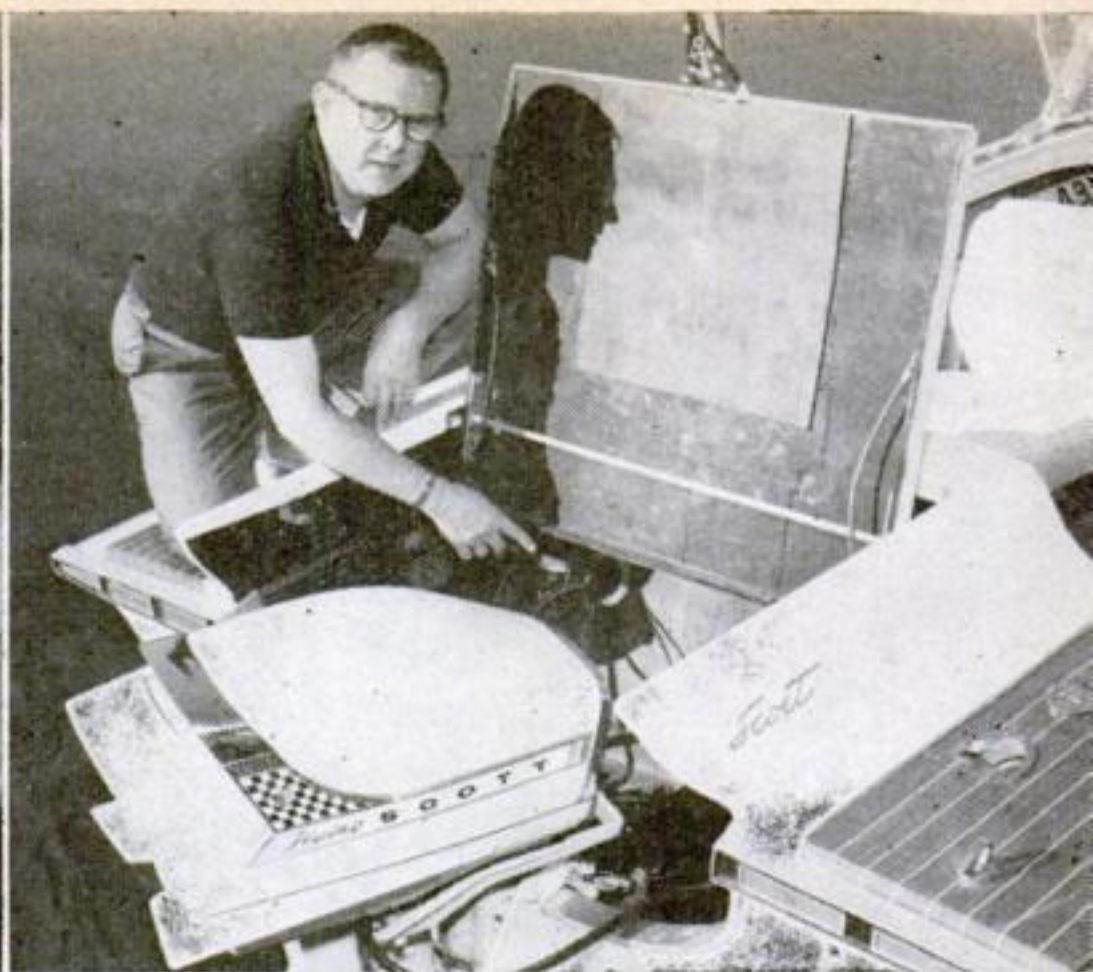
vides maximum bow-deck space. Under the floorboards, longitudinal fiber-glass stringers give the 17-foot boat rigidity and strength.







**Control area** is fully instrumented, with everything at the driver's fingertips. There's even a glove compartment—as in a car.



**Sealed motor well** has only one opening forward into the boat itself—a small hole where all controls, cables, and gas lines converge.

ivers and lakes all across the country, besides offering hazards and opportunities ideal for boat testing: lots of marine traffic, shallow water where one least expects it, bridge supports in midstream—and long stretches where we could open her up to see how high the needles would go.

**Testing for portability.** Our test actually began on land, as we hitched up and towed the Flying Scott to the test site. To be handy and useful, an outboard craft must fit handily into a normal garage and trail easily, with no sway and a minimum of bouncing. At the water, it must launch easily and recover easily onto the trailer.

These points make it simple for a boat owner to sample interesting bits of water in many locations. The Scott boat passed all dry-land tests with high marks.

Afloat she was as lively as a new colt. With three aboard, I pushed the throttle full forward. In 10 seconds the speedometer registered 25 miles an hour. Later, with five men and camera equipment aboard, the response seemed not noticeably slower.

The 17.D.75 takes tight turns without strain. At full speed you pull back the throttle just before spinning the wheel, then give her the gun part way through the turn. This method gives you a detailed look at the water if you're sitting on the side of the boat on the inside of the turn. Still, in repeated high-speed turns, which involved constant crossing of our own wake, we took

only a few drops of water aboard. In fact, with its quick response to the wheel, the boat seems to invite such spectacular turns.

**No periscope needed.** Another thing we wanted to check was the fore-aft attitude of the hull under different load and speed conditions. Some boats stick their noses up so high you need a periscope to see where you're going. Not so this craft. At almost any load weight and distribution, and any degree of acceleration, we always had perfect visibility forward.

The Scott people claim that the craft has the "43 most-wanted features" boatmen desire in a boat. We didn't keep count beyond the first 15 or so, but we'll take their word for the 43.

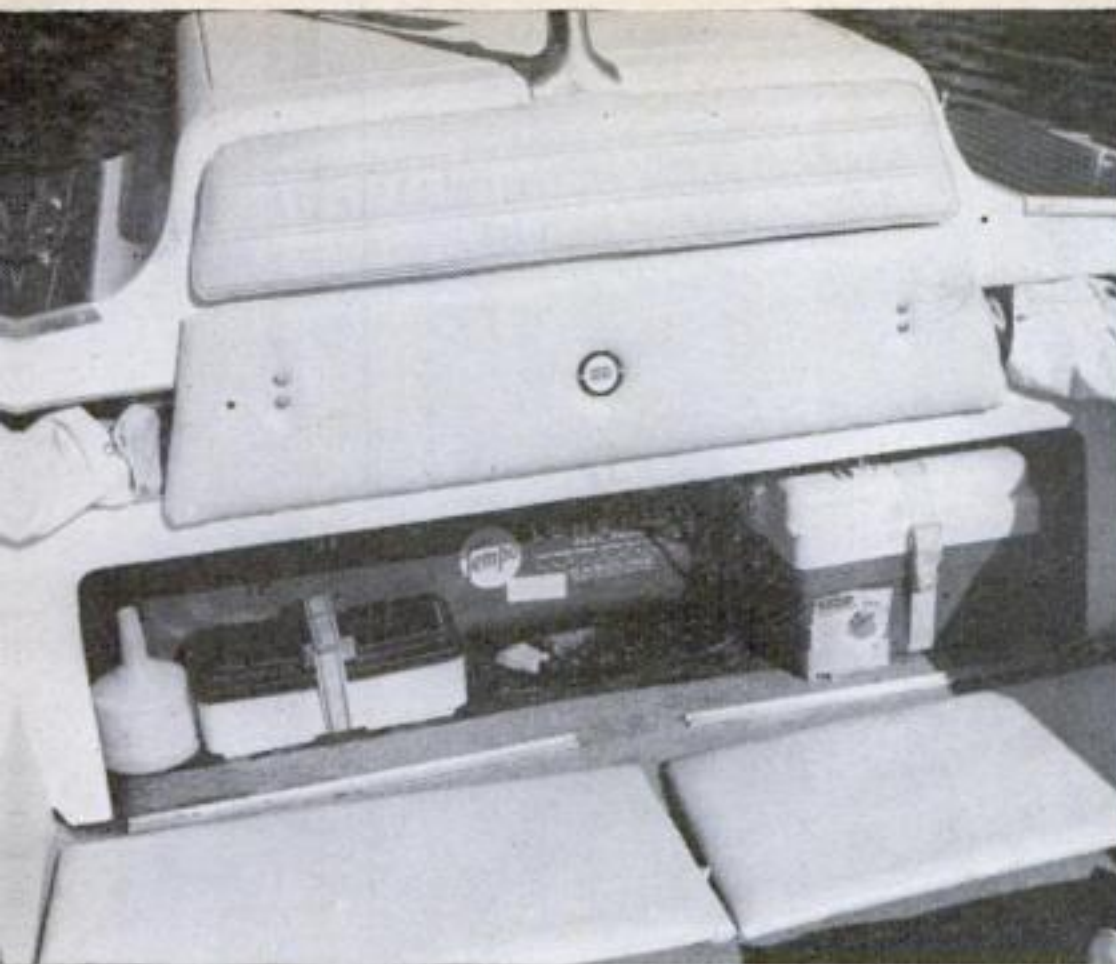
Take a look, for example, at the folding bow ladder. When opened, it extends out of the forward hatch, over the bow and into the water—a great place for taking aboard a swimmer or skier, far away from the propeller. The ladder stows out of sight under the forward hatch.

This hatch itself is worth a bit of study. It's covered by three-foot-long sections of the forward deck that pivot out from the center. With these open, you can walk—instead of scrambling like a goat—from the cockpit forward to the bow. The clear-plastic windshield tilts up out of the way.

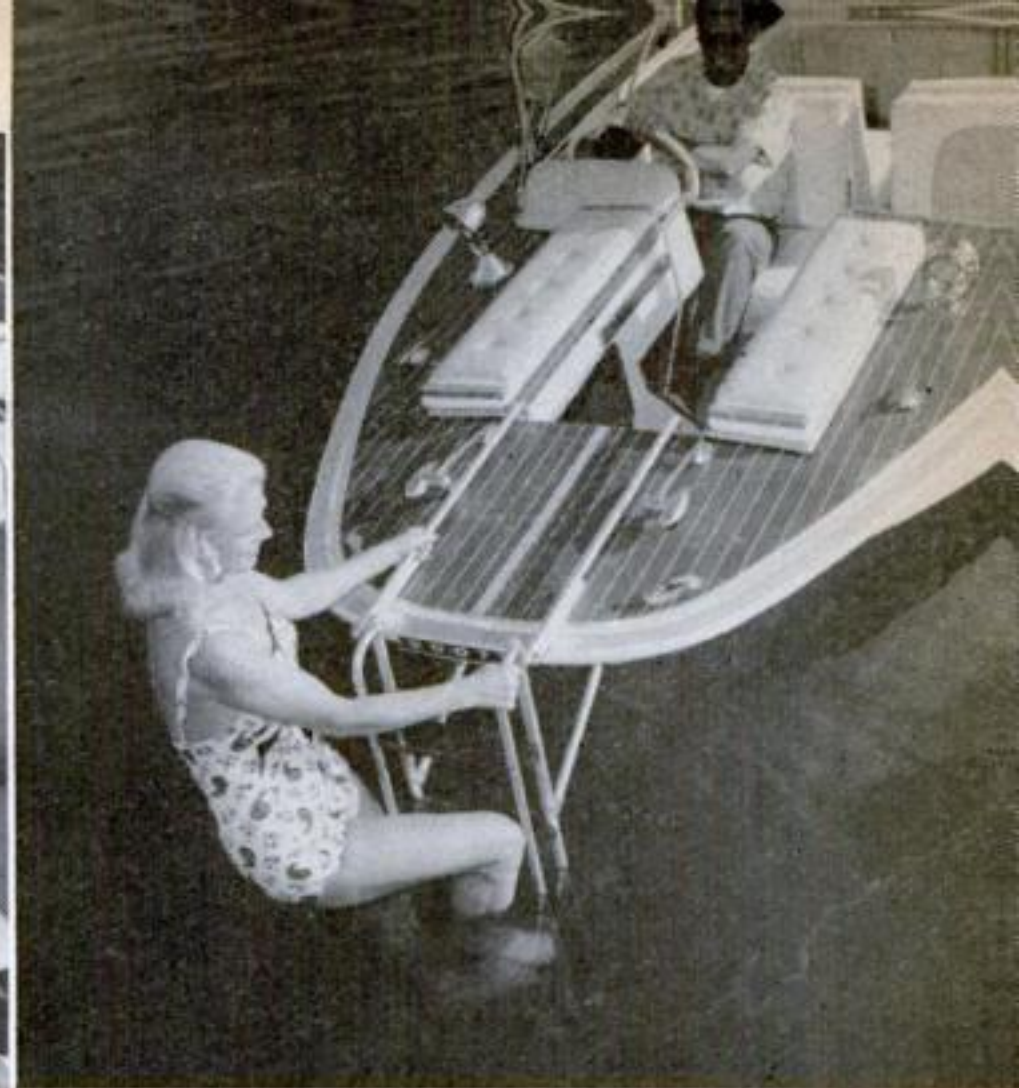
**The disappearing top.** Most convertible tops fold forward when not in use, forming

*[Continued on page 182]*





**Storage space** at stern has built-in fuel tank, battery box, sump for Bail-a-Matic, and room for a toolbox, funnel, and other gear.

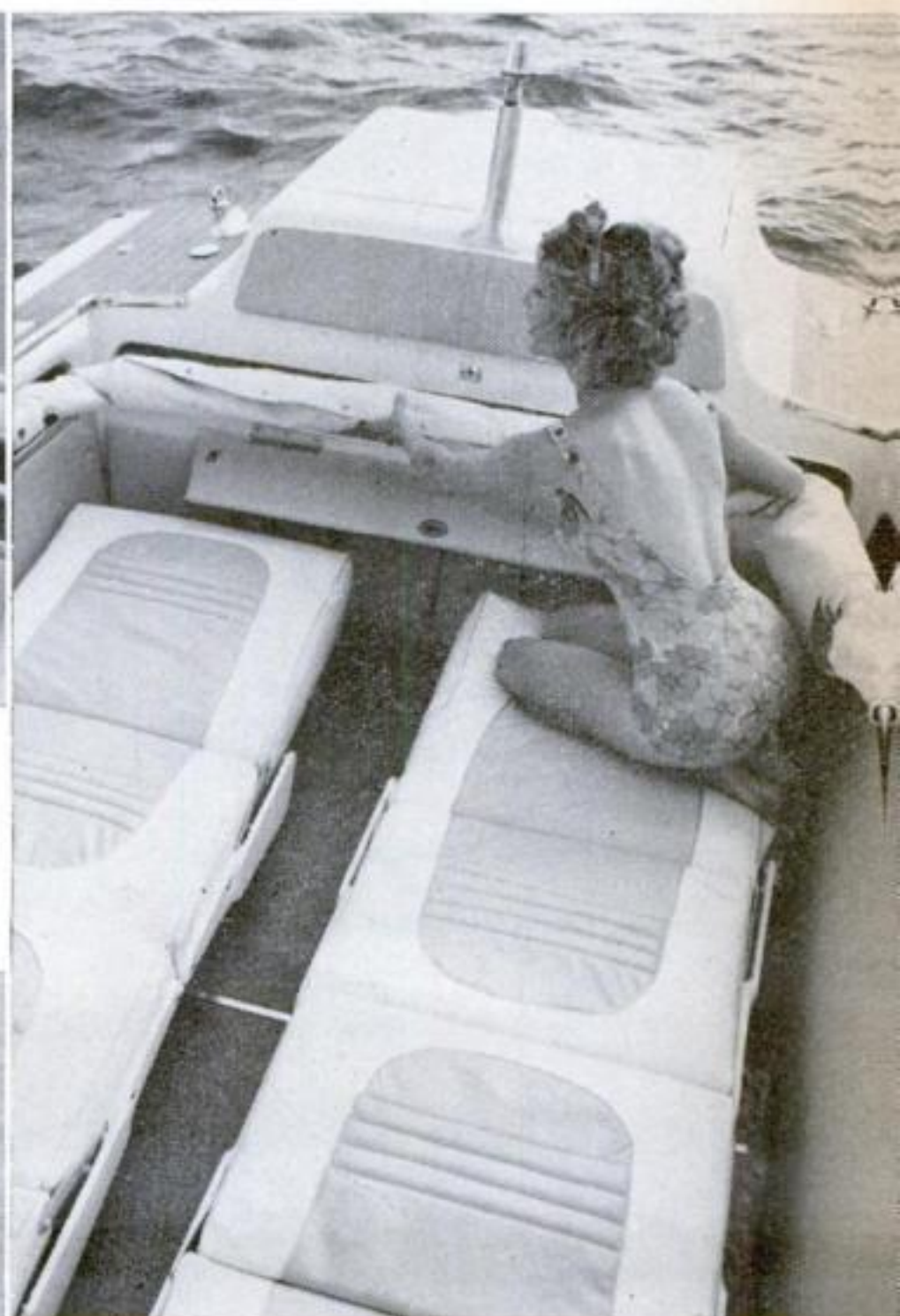


**Bow-mounted boarding ladder** is permanently installed, folds under the deck. Hatchways in deck open to form pass-through from cockpit.



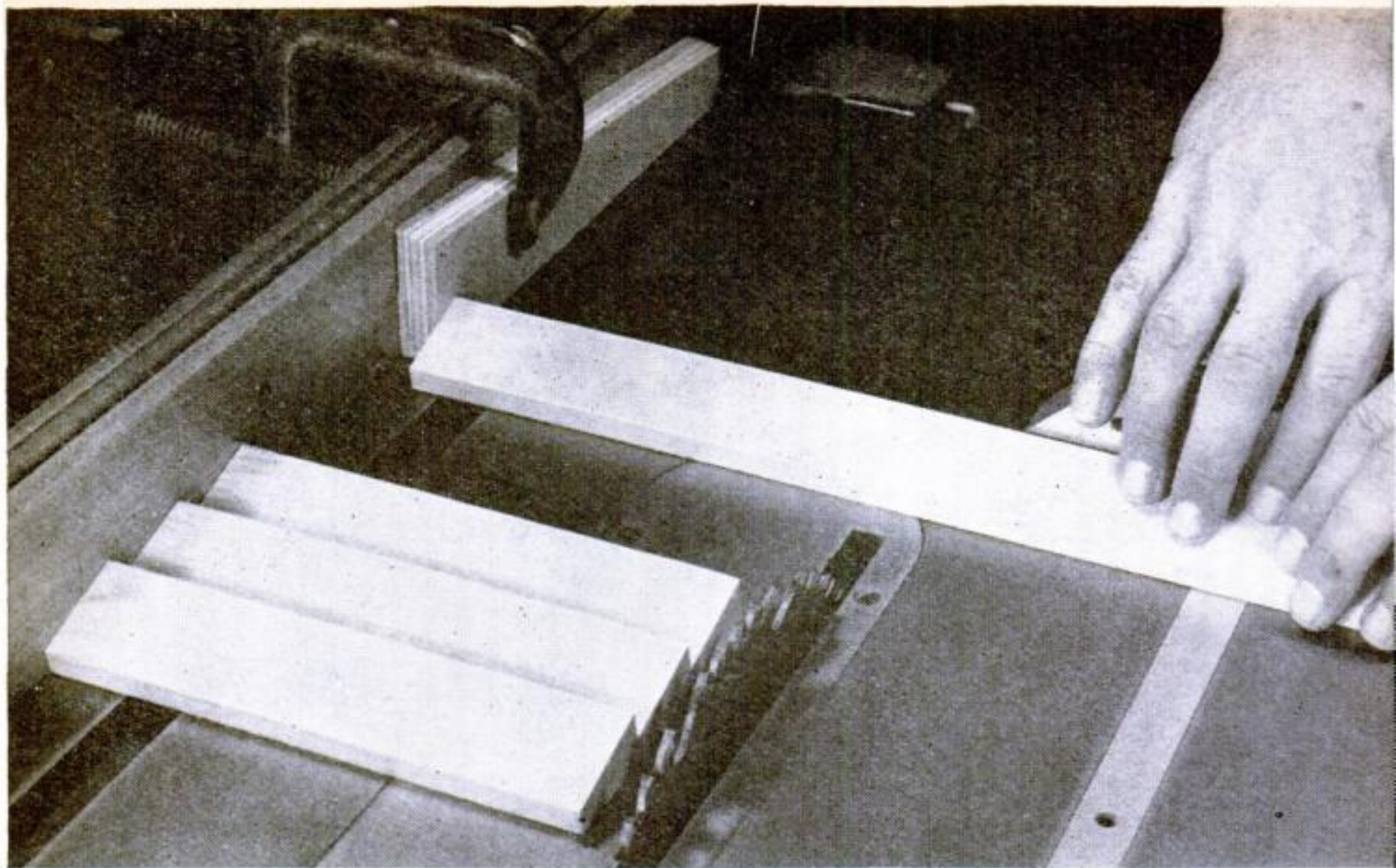
**A pair of skis** stow on each side of Flying Scott in special bins. Tow rope fastens to deeply anchored pylon, seen in photo at right.

**Windshield** raises easily and locks in any desired position. With windshield up, you can walk from the cockpit to the bow ladder.



**Fabric top** folds back and stows behind hinged panel. The seats fold flat if you'd like to nap. Cost of boat, complete: around \$3,200.





When sawing sections to length, use a stop block on the rip fence to gauge the length of

cuts. With the block, you'll avoid jamming the pieces between the blade and the fence.

Pie-wedge cutting on  
a table saw turns out—

# Round Shapes from Flat Boards

By R. J. DeCristoforo

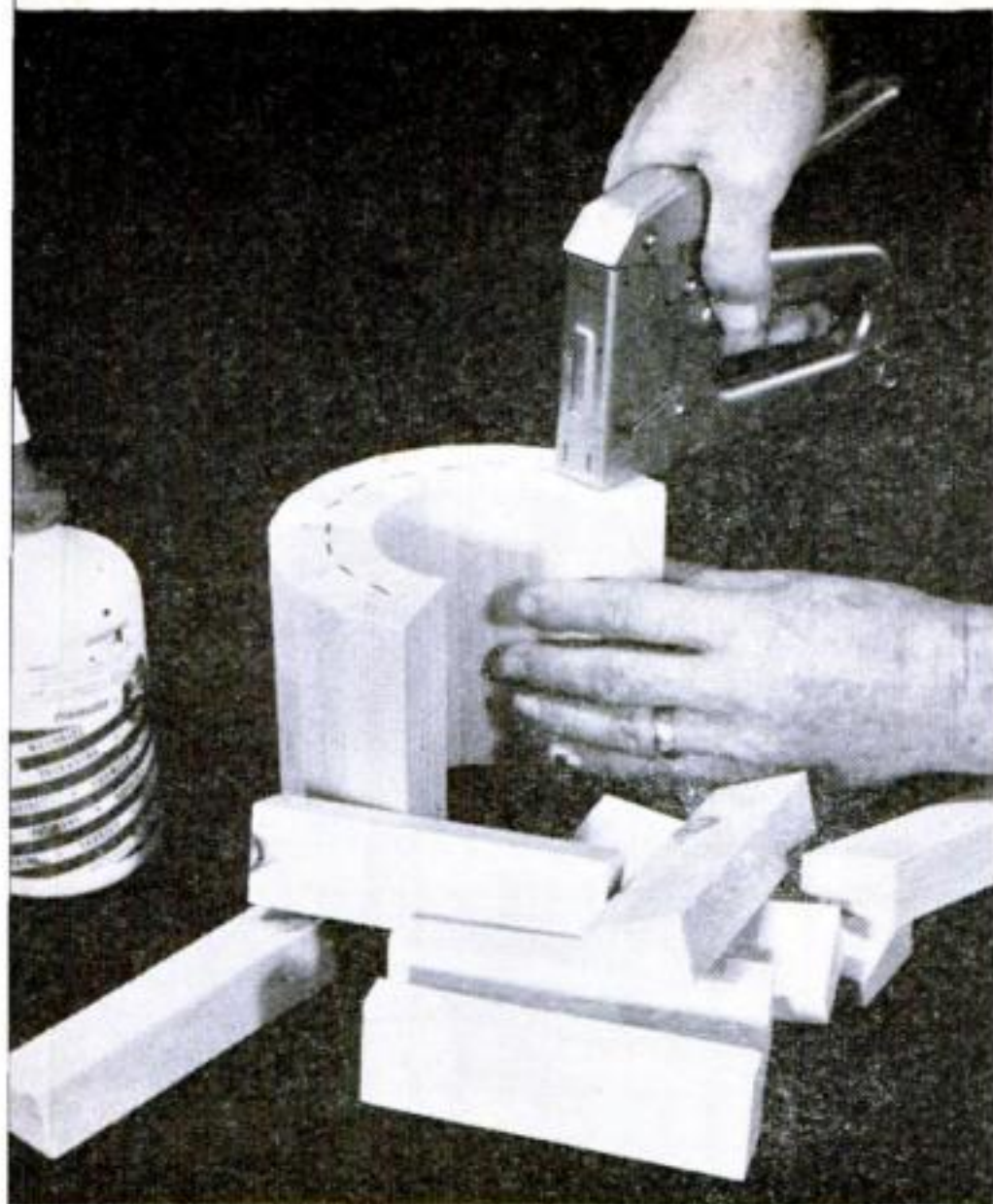
**I**T'S a fact: Saw a flat board into wedge-shaped strips, join the pieces edge to edge, and they'll form a complete circle, like pieces of pie. The only trick to it is that the angles of the saw cuts must add up to 360 degrees.

The simple method opens the door to unusual shop projects that would be difficult or impossible any other way. You can build up large circular shapes without having to carve them from solid blocks of wood, thus saving time, effort, and material. You can put fancy curves on projects. You can design table aprons, round ottomans, curved chair backs, circular seats, and similar projects without worrying about how to bend the parts to shape. You can save money by using relatively thin material to form big shapes like round columns or large bowls.

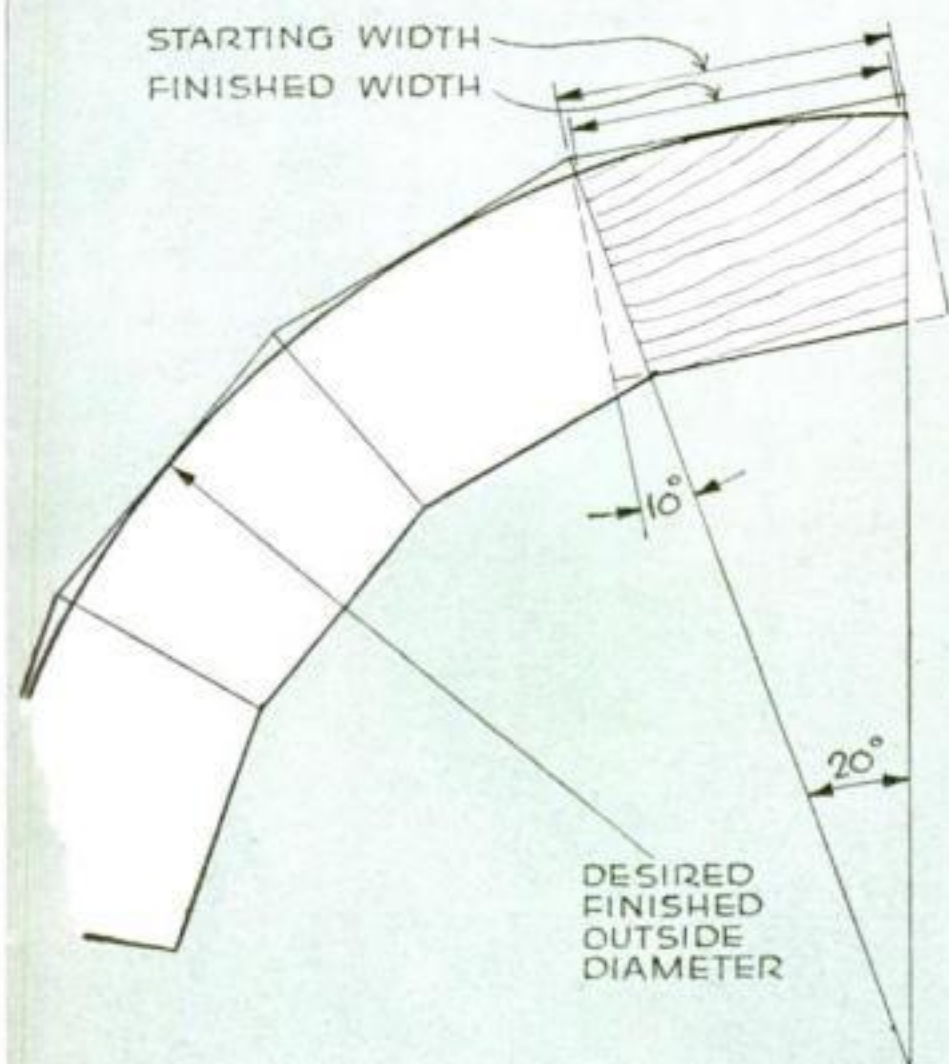
**Figuring out the angles.** This is easy. Divide 360 by the number of pieces you want in your circle to find the total angle that each segment will have. Then divide this in half to get the angle at which each side of the segments should be cut.

You do have to be accurate, however, when setting the saw. Part of a degree doesn't seem





Staples can act as clamps for assembly of segmented projects. Apply a light film of glue to the mating edges and hold the pieces tightly together as you drive home the staples.

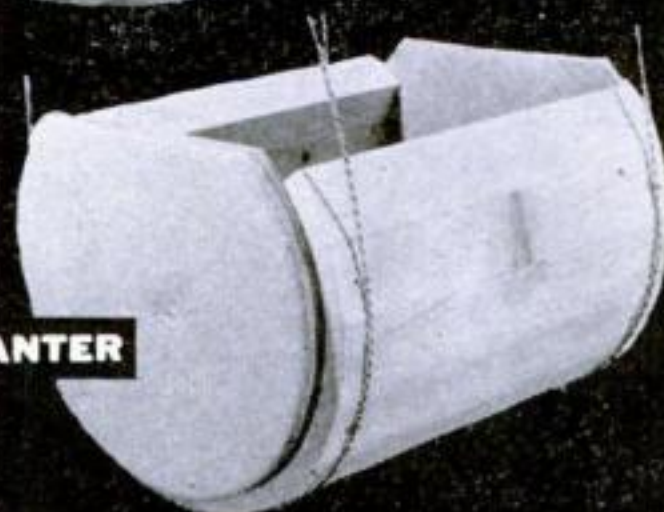


Figuring the angles: Divide 360 by number of segments to find angle of each, then divide this in half to get bevel. Lay out segments to allow for slight loss of width in rounding.

## Mechanics and Handicraft SECTION



**BUCKET**



**PLANTER**



**ASH TRAYS**



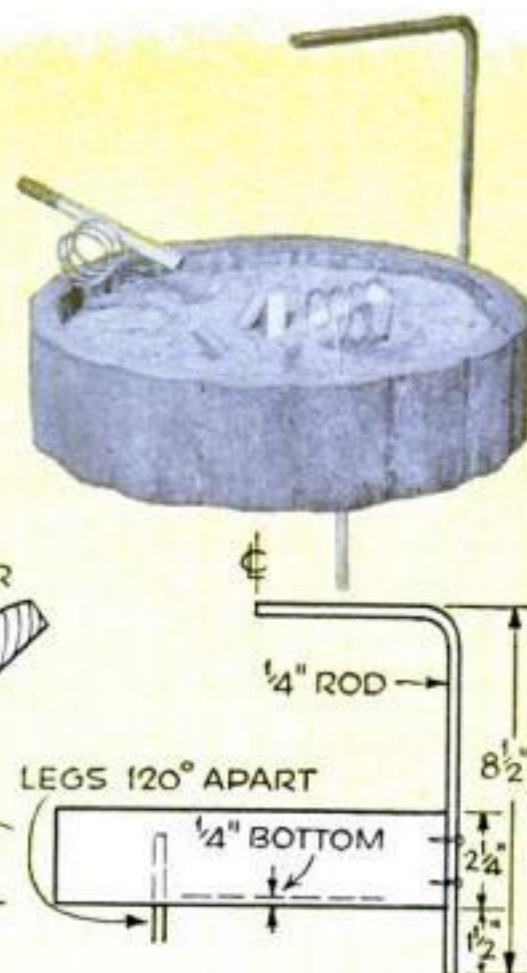
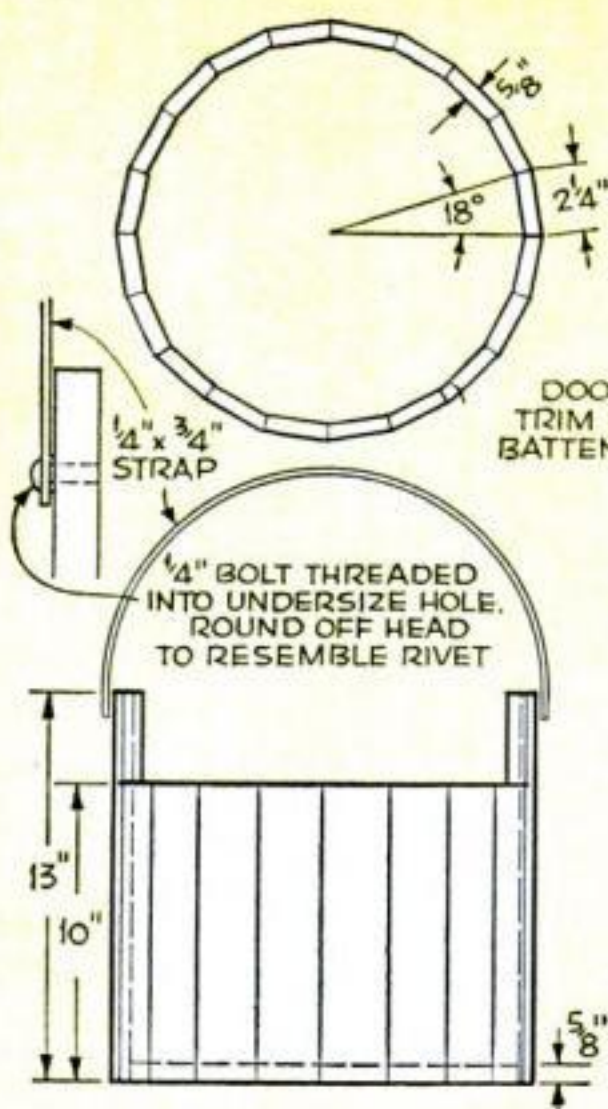
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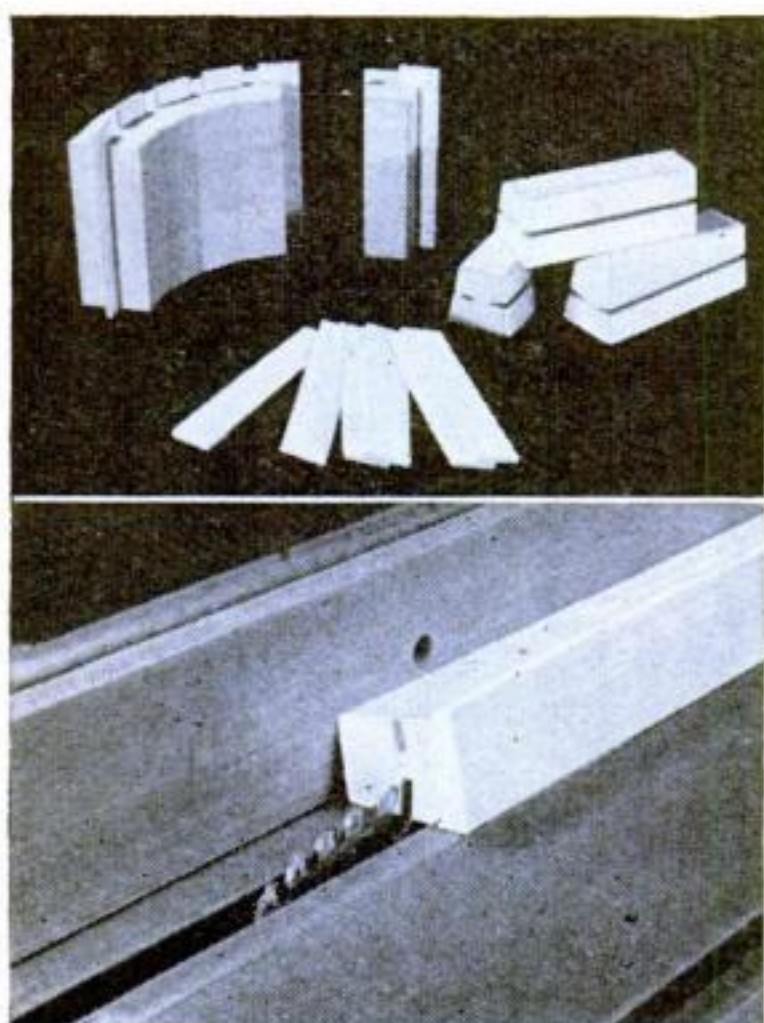
## Four useful items you can quickly turn out



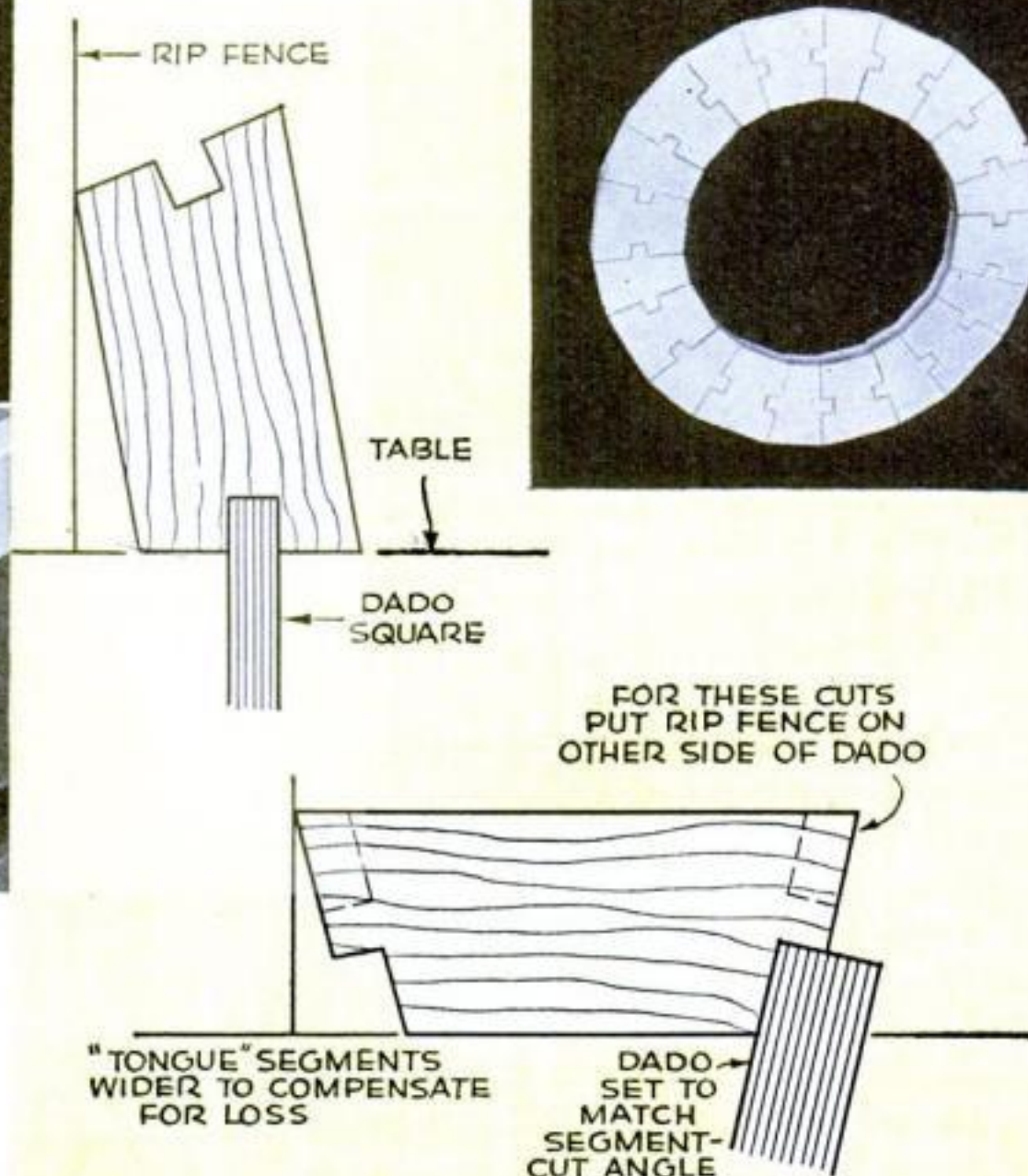
The old oaken bucket moves indoors to make this dandy magazine stand. Because of the bevel-segment technique of forming the circular container, it's simple to put together.



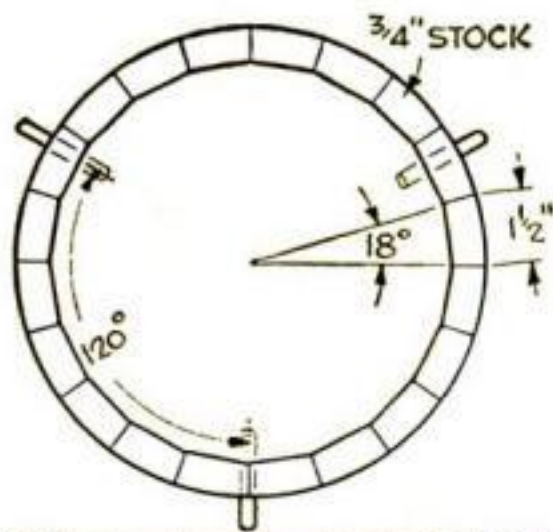
Scalloped effect on this modern ash tray was created by using standard door trim for segments. You can use a variety of moldings in a similar manner to produce other shapes.



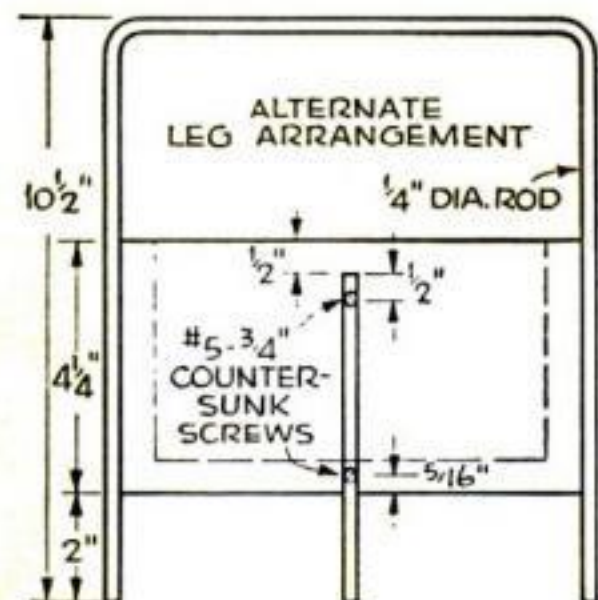
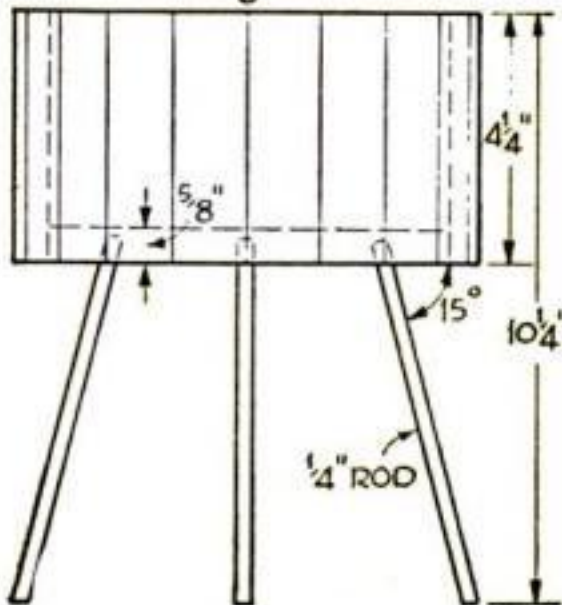
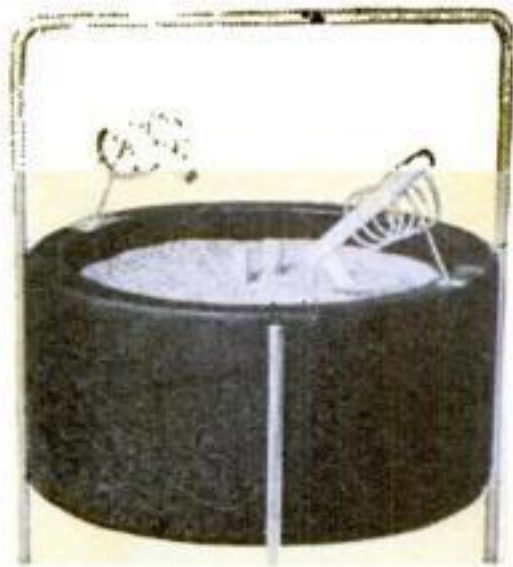
**Two ways to make strong joints:** Segments can be pinned together by gluing thin splines into simple saw-kerf slots, as above. Cuts must be square to beveled side and all made with blade and fence in same position. At right is shown a method for making sturdy tongue-and-groove joints.







Sand-filled patio ash trays are eye-pleasers, can be made in many styles. One at right has bent-rod handle; one below, tripod legs glued into bottom holes. To form the cigarette-holder coils, wind galvanized wire around 1" tube or dowel.

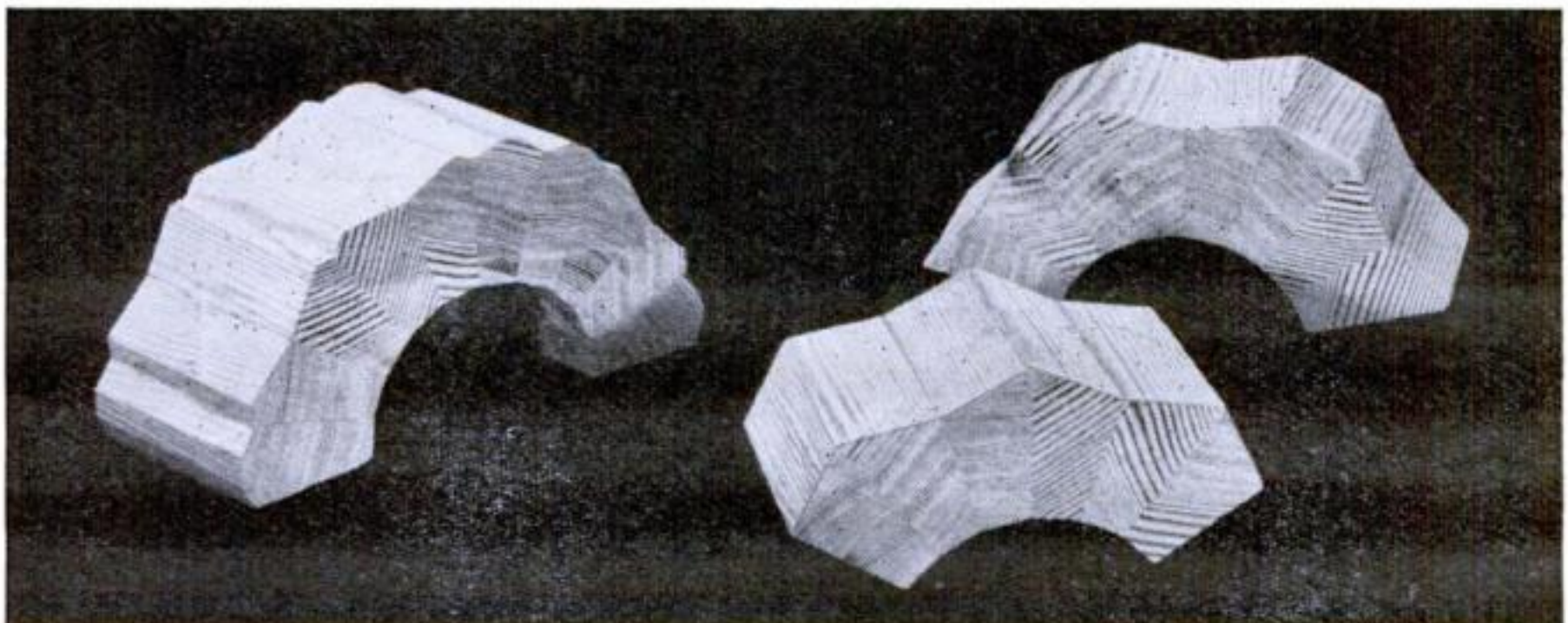


like much of an error, but when it is multiplied 10 or 20 times it leaves a harrowing gap when you come to fit the last segment. Best bet is to check a trial cut on scrap wood with a protractor. Make any adjustments before cutting good stock.

The size of the circle is determined by the number and width of the segments. The more segments you use, the closer to

a true circle you get, but too many very small pieces can be a problem to assemble. Actually, it will surprise you to discover how little work is required to bring a segmented assembly to full round.

To find the best segment width, make a scaled or full-size layout of a small section of the circle. Then divide the circle into the smallest number of segments that will

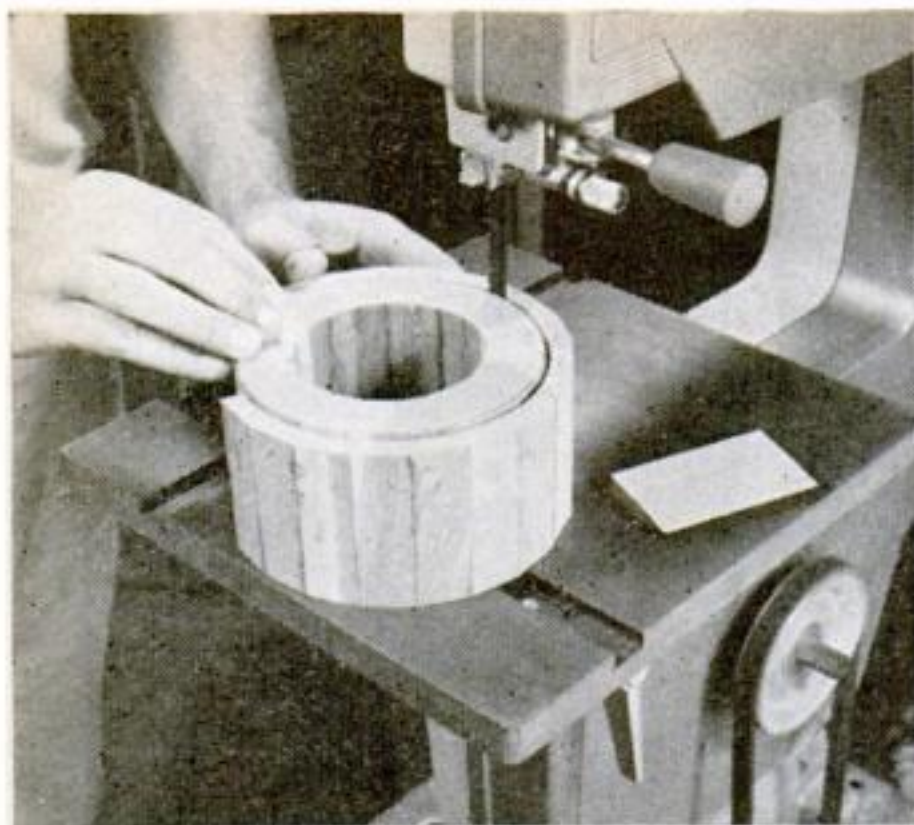


Cylinder sections above show how you can create fancy outside surfaces by making simple,

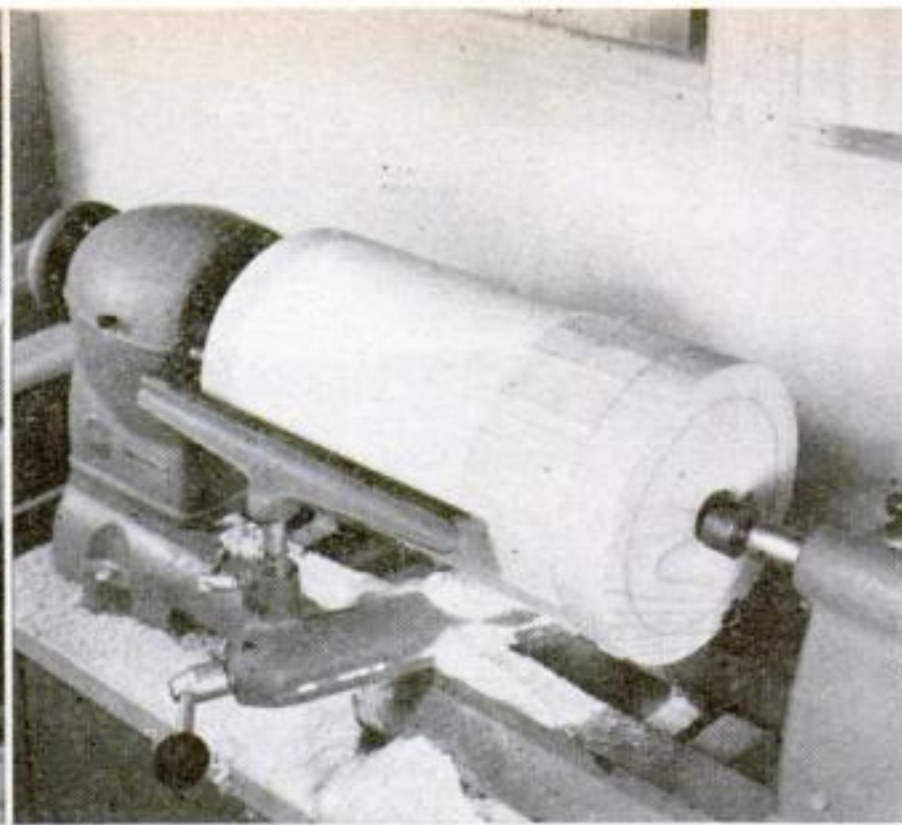
straight saw cuts on outer edges of the segments before you assemble and glue the parts.

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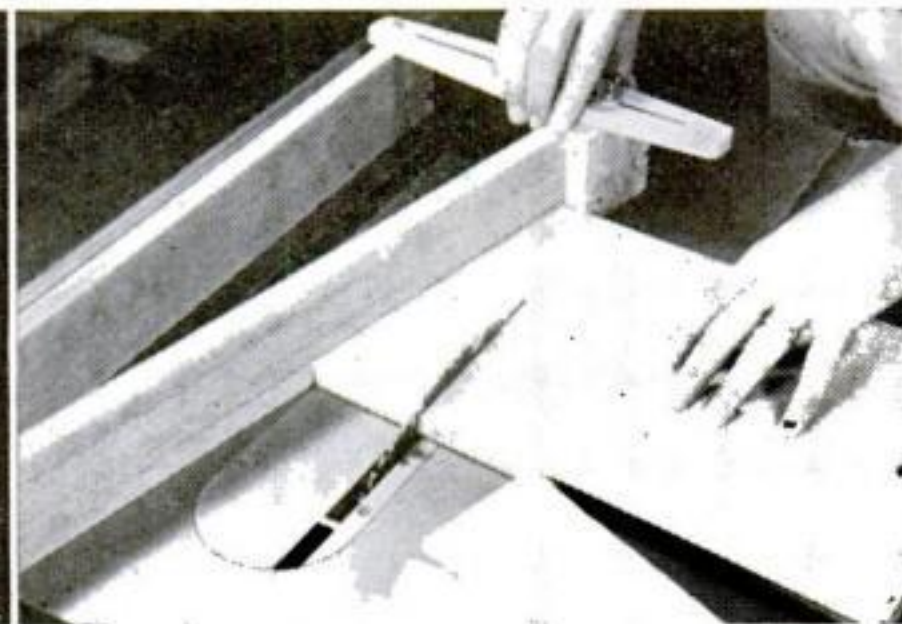
When the size permits, you can quickly saw out a round form on a bandsaw. With such a blank, you can control the grain to achieve special effects with contrasting woods.



With surprisingly little lathe work, a segmented piece will appear as a solid cylinder. The working depth to which you can go, of course, will depend on the thickness of the blank.



To make truncated-cone shapes like these, use the same techniques and the same formula you



would for other segment work—except in sawing out these segments. Then use a taper jig.

do the job according to the thickness of stock you're using. You'll find that the thinner the stock, the more segments you'll need. Segments can be cut to length and then beveled, especially if you are using up odd lengths of lumber, or you can do the beveling first on long pieces.

**Joining the wedges.** Band clamps would be ideal for holding the segments together during gluing, but strong clothesline twisted tightly about the project will do a satisfactory job. Many times, especially on smaller projects, you can do away with clamping entirely by using staples or corrugated fasteners to hold the parts together until the glue dries.

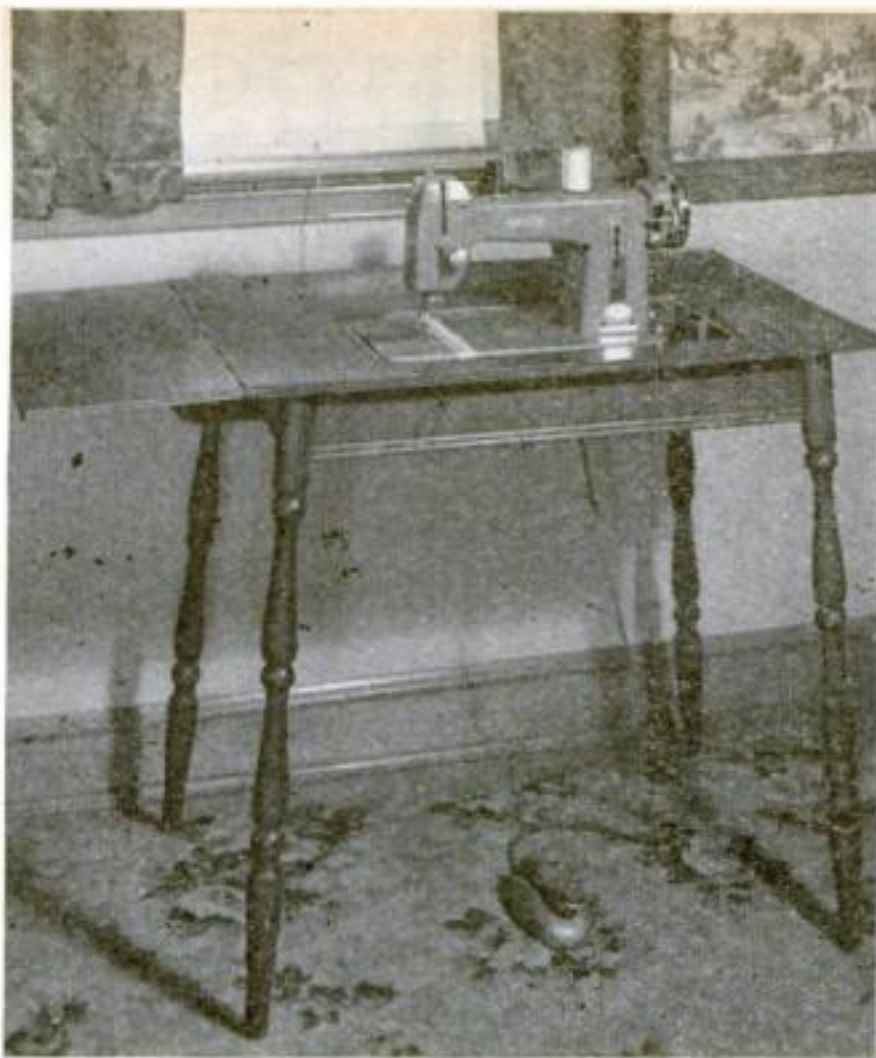
Don't use a lot of glue or the parts will be too slippery to hold in correct alignment. A little film of glue on both edges, allowed to get a little tacky, is easier to

work with and will be equally as strong.

A spline joint is very strong and has the advantage of keeping the parts in alignment when you apply pressure. But don't size the splines so they must be forced into the grooves. The splines should fit easily and leave some room for glue. And remember that splines are strongest when they are cut so that the grain runs across the small dimension.

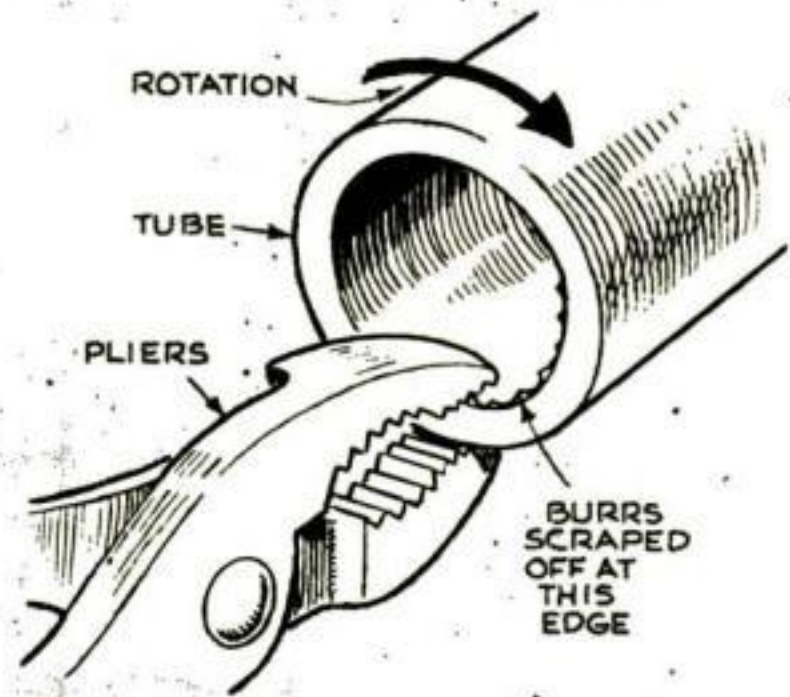
The tongue-and-groove joint also has high strength, but the cuts must be very accurate. Another, quite simple method of assembly is to add one segment after another, gluing and nailing as you go. Work toward two half circles so you don't close the ring up. The half circles are finally put together under clamps or by stapling. Be careful of nail placement if you are assembling a column for turning. ■ ■





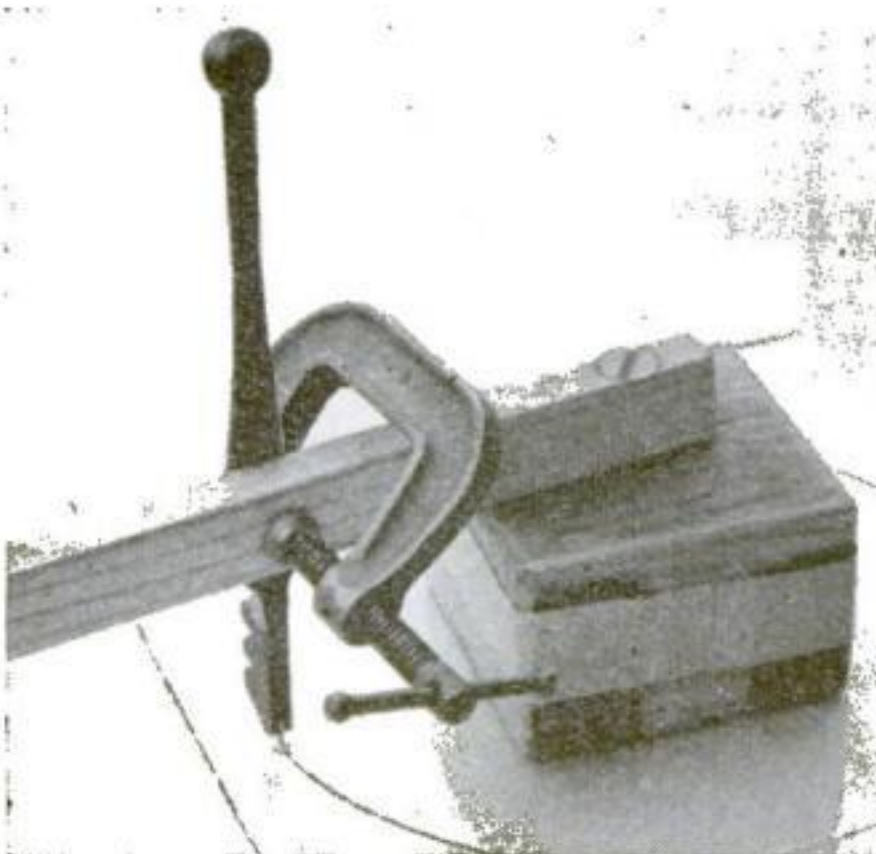
## Table makes room for sewing

Set a portable sewing machine flush in an old kitchen table with a drop leaf, and you give the operator a large working area. Just cut out a hole sized to accommodate the base of the machine and screw a couple of wood strips on the underside of the table to support the machine firmly.—*Karl J. Krausse, Rockville, Md.*



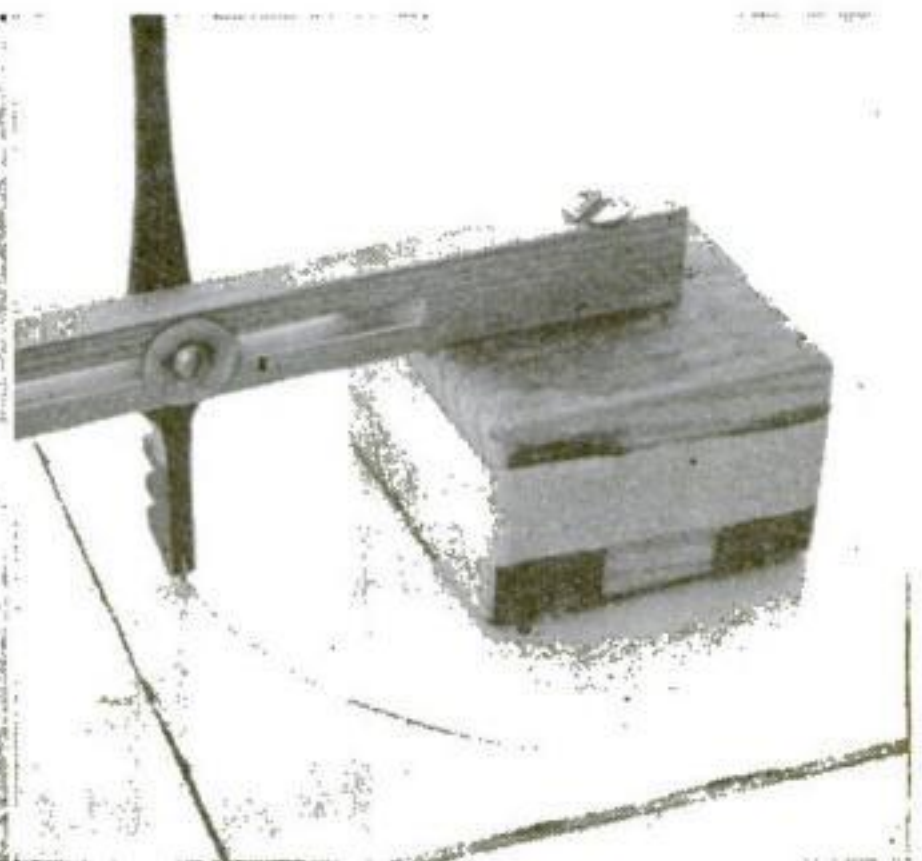
## Pliers get rid of burrs in pipe

I find that a pair of pliers—that universal tool—works fine for deburring the inside of metal pipe or tubing after hacksawing. I grip the cut end lightly with one jaw inside the tubing, one outside. As I rotate the tube, the burrs are scraped off against the side of the jaw on the inside of the pipe.—*W. B. Rasmussen, Prosser, Wash.*



## Easy way to cut out glass disks

A guide like this makes cutting glass disks easy. Clamp the cutter to the arm of a 2"-by-2"-by-1½" block, or attach it permanently as at right. Place the glass on several sheets of paper and put the block



on the glass. (Friction tape on the bottom of the block keeps it from moving.) Keeping moderate thumb or screwdriver pressure on the center screw, rotate the cutter with firm, even pressure. Remove the guide and tap the glass at the break line.—*W. O. Michaelis, Olympia, Wash.*

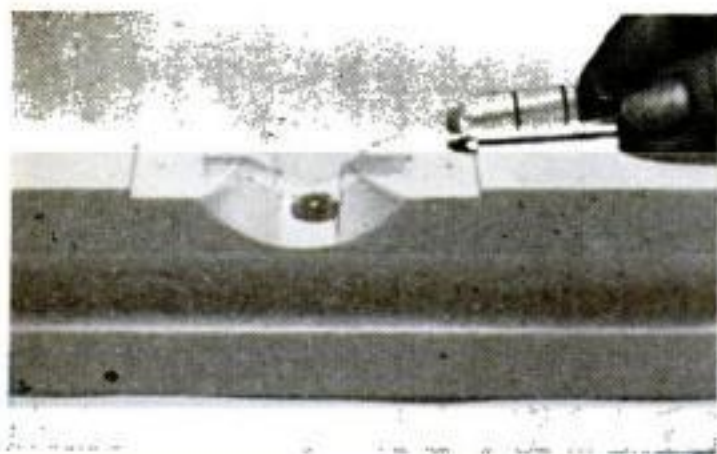


# It Sounds Off

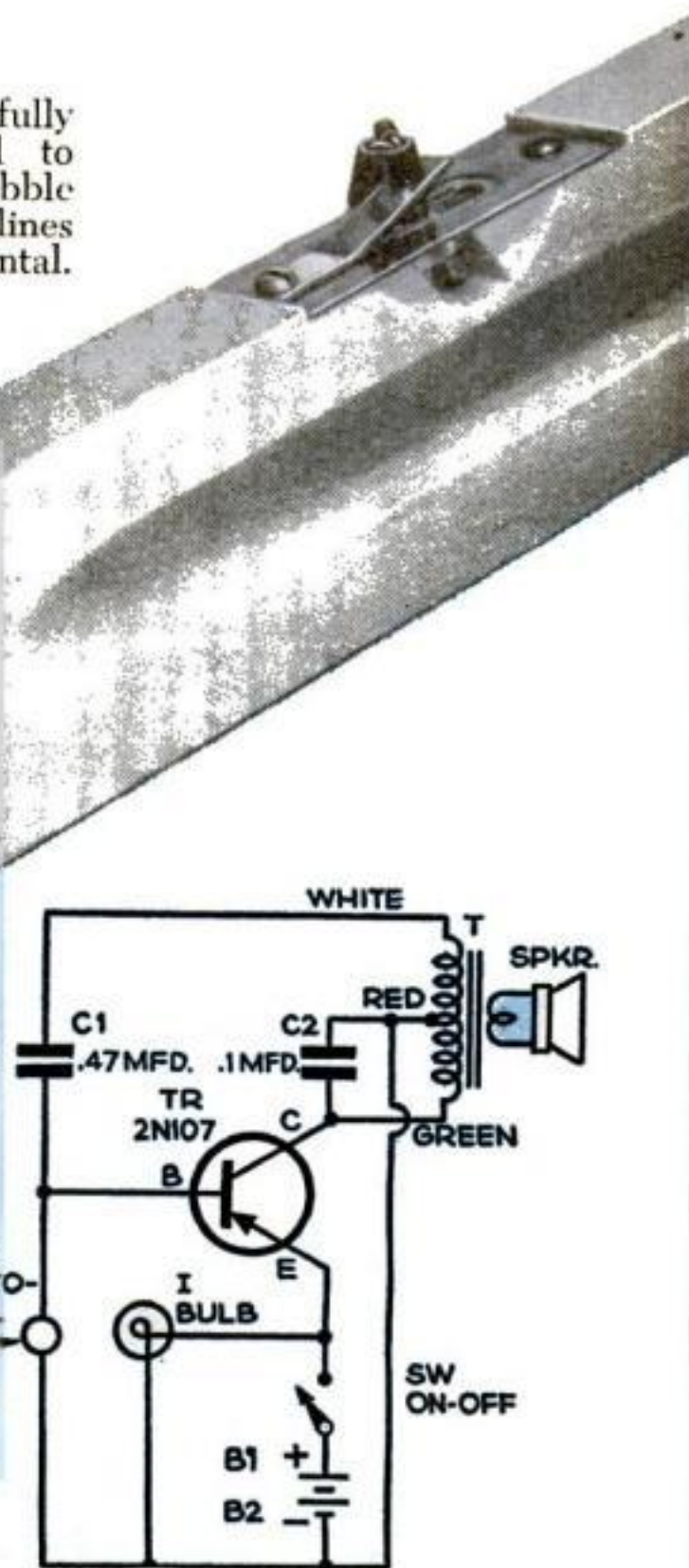
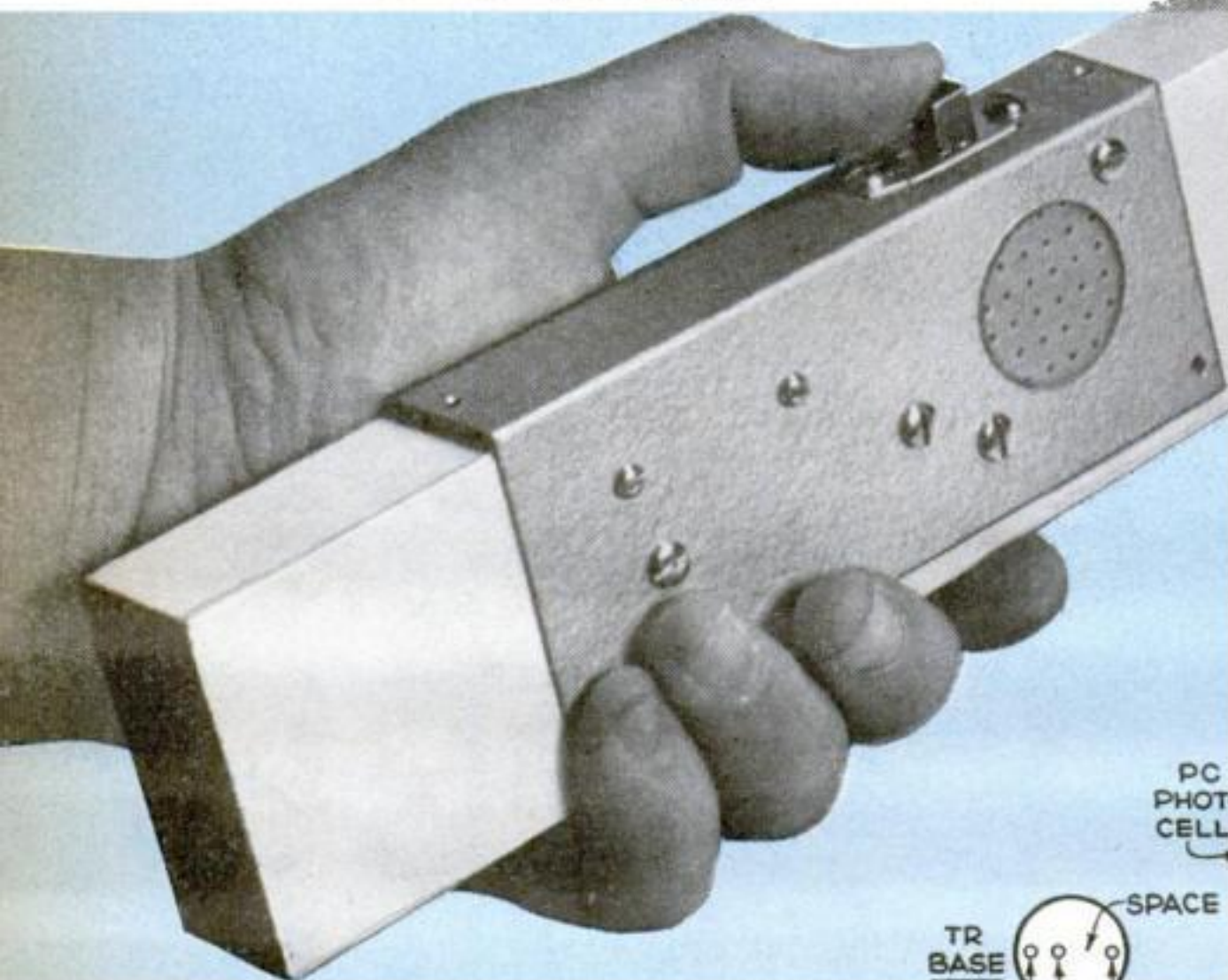
With this simple device built into your level, you can do carpentry jobs by ear

A NOISY carpenter's level may seem as goofy as a left-handed screwdriver but it's a practical tool for framing in hard-to-see places. It will tell you the "truth"—out loud—about a sloping overhead joist or any off-horizontal member out of easy sight of the bubble.

A tiny photocell, a pilot-light bulb, and a simple transistor circuit are all you need to make any standard 24" wooden level sound off. The photocell "reads" the position of the bubble when it is between the



Glass tube must be carefully remounted, after removal to install bulb, so that bubble is centered between hairlines when level is exactly horizontal.





# on the Level

By Len Buckwalter

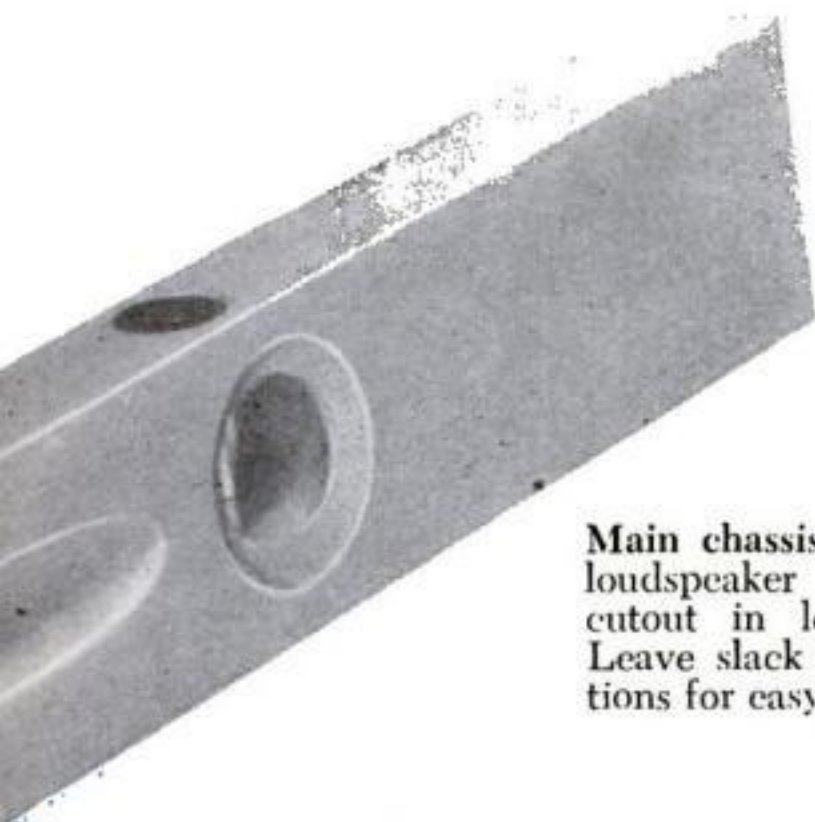
hairlines. Flip on the switch, and you hear a squeal that drops sharply in pitch when the bubble is centered. The difference in tone is distinct and sharply defined. With a few minutes' practice you can center the bubble as accurately as you can by eye—even in the dark.

Cut out a section of the level as shown in the drawing to make room for the main

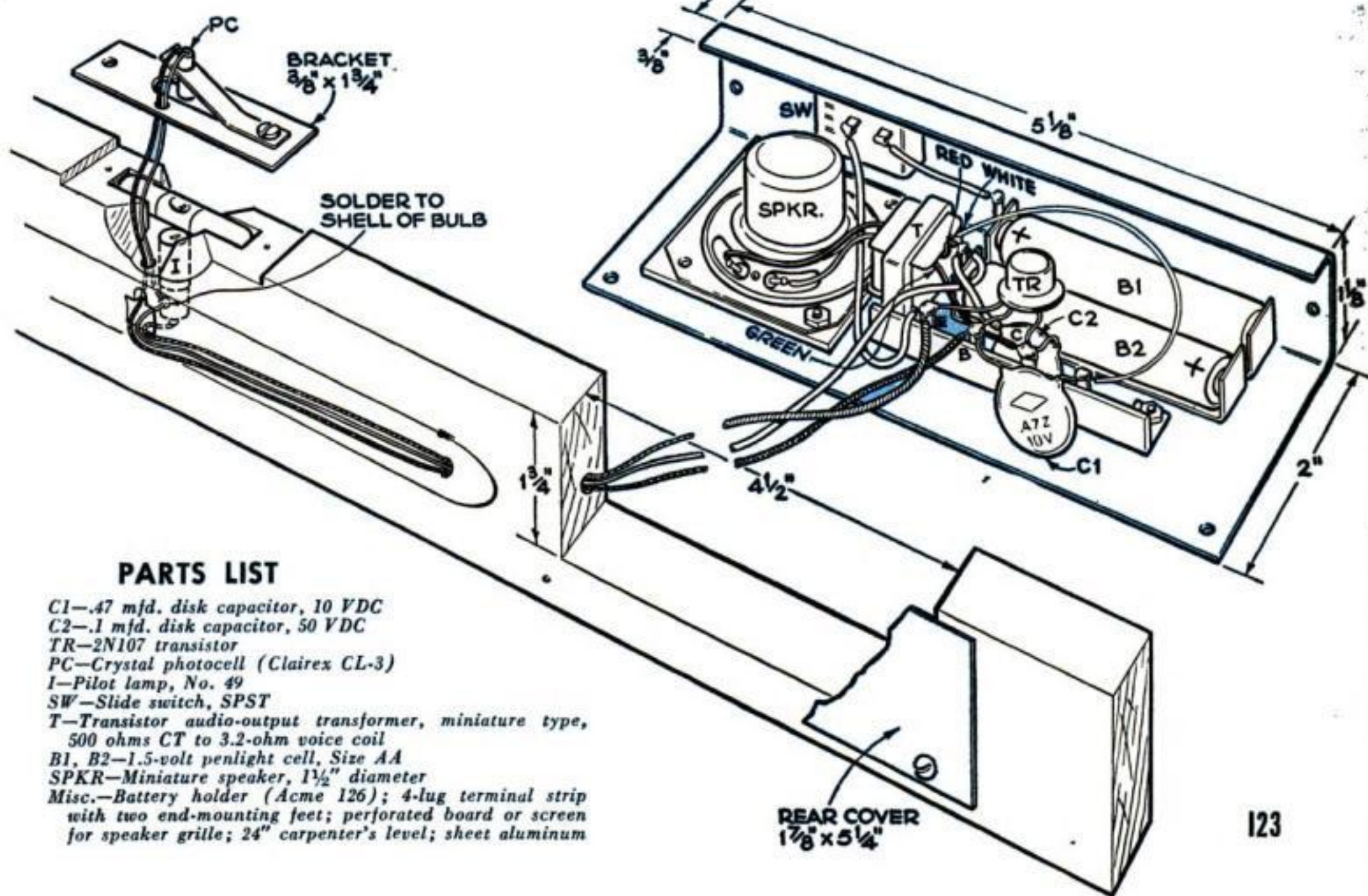
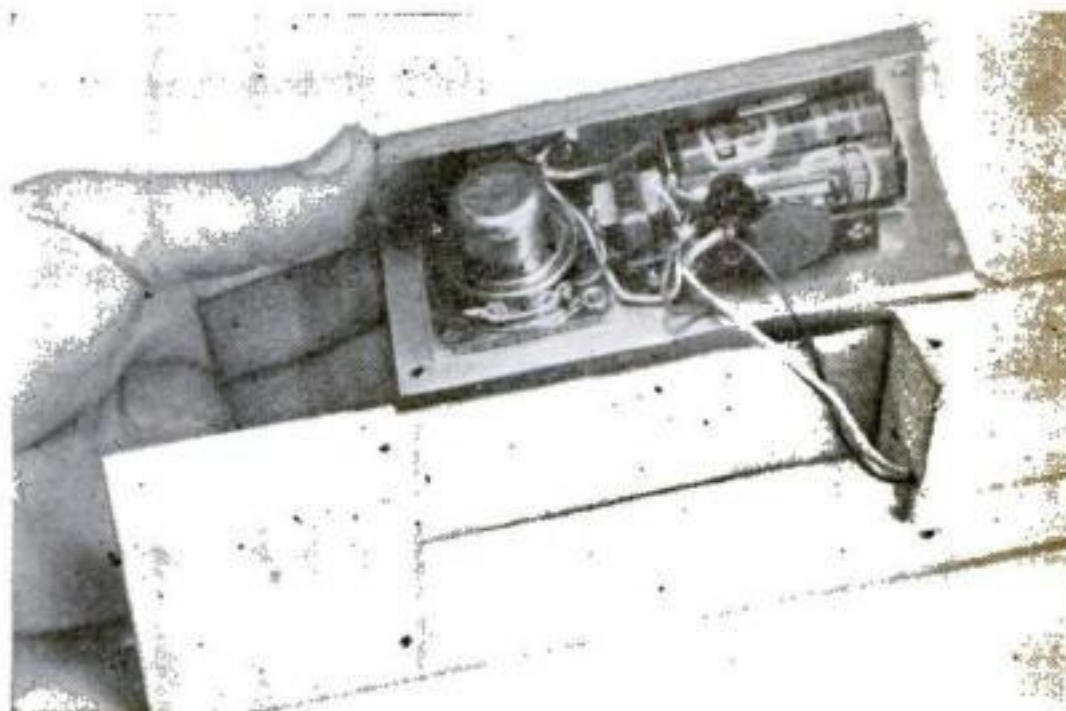
chassis. Bend the chassis to shape out of sheet aluminum. Test-fit the chassis and drill holes for mounting screws. Drill a hole in the side of the level angling into the chassis space to permit three wires from the main chassis to run to the lamp and photocell.

Remove the metal plate covering the glass tube on top of the level. You'll find

CONTINUED



Main chassis with tiny loudspeaker fits into cutout in level body. Leave slack in connections for easy wiring.



## PARTS LIST

- C1—.47 mfd. disk capacitor, 10 VDC
- C2—.1 mfd. disk capacitor, 50 VDC
- TR—2N107 transistor
- PC—Crystal photocell (Clairex CL-3)
- I—Pilot lamp, No. 49
- SW—Slide switch, SPST
- T—Transistor audio-output transformer, miniature type, 500 ohms CT to 3.2-ohm voice coil
- B1, B2—1.5-volt penlight cell, Size AA
- SPKR—Miniature speaker, 1 1/2" diameter
- Misc.—Battery holder (Acme 126); 4-lug terminal strip with two end-mounting feet; perforated board or screen for speaker grille; 24" carpenter's level; sheet aluminum



the tube embedded in hard putty. Use a small screwdriver to dig out just enough putty to unseat the glass. It's important to leave undisturbed as much of the putty base as possible—it will be your guide for accurately remounting the tube.

**Sizing the bubble.** Compare the size of the air bubble with the diameter of the photocell. If it's larger, it should be reduced in size to the exact diameter of the photocell for maximum accuracy. To do this, run a fine file over the pointed end of the bulb until you've made a small hole, and add rubbing alcohol to decrease the bubble size. Reseal the tube with a dab of epoxy cement and let the cement harden overnight with the tube vertical.

Before the glass tube is re-installed, drill the hole to receive the pilot light, which should be centered directly under the tube. Cut a hole through the side of the level intersecting this hole. Solder a piece of hookup wire, long enough to reach the chassis, to the button contact on the bulb and insert the bulb in the hole. Working through the access hole in the side, solder a second wire to the shell of the bulb after it is inserted in its mounting hole. For proper operation, it is essential that this wire from the shell connect to the negative terminal of the battery holder. Also note that one lead from the photocell will be soldered to the bulb shell. Remount the glass tube with putty, making certain the hairlines face up. Drill holes in the metal retaining plate for the photocell wires and use spaghetti on the leads to prevent shorts.

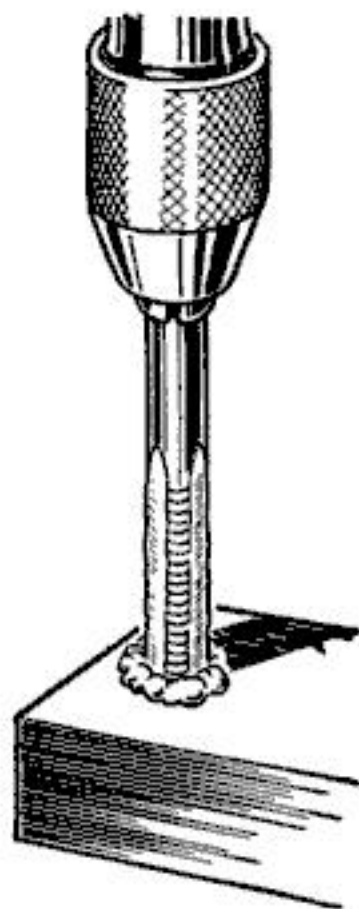
**Wire the main chassis,** following the pictorial diagram for parts placement and checking the connections against the schematic wiring diagram. Leave enough slack in the wires connecting to the bulb and photocell to allow easy removal of the chassis for changing batteries.

The completed job must be carefully aligned for accurate results. Place the unit on a level surface (check with a level known to be accurate). The bubble should be exactly centered between the hairlines. If it's not, you have not remounted the glass correctly. If it is, turn on the switch. Lift one end of the level. The tone you hear should go up in pitch when you lift either end of the level. Adjust the position of the bulb and photocell until you hear the lowest-pitch tone when the level is resting on a level surface. ■ ■

## Can of fat is handy in home shop

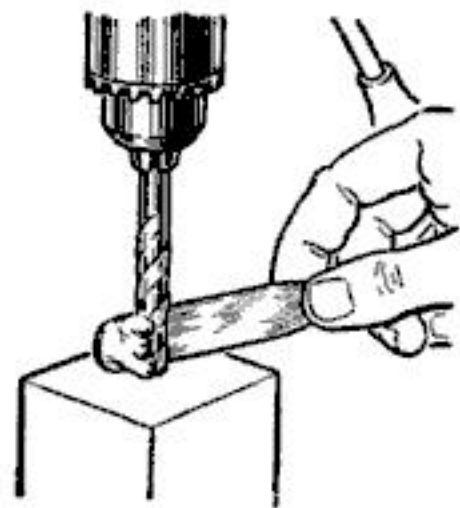
A container of waste fat salvaged from the kitchen can be one of the most useful items in any home shop. I have used it for years as a metal lubricant. Store such fats as bacon drippings and lard in a jar with a screw-on cap or in a one-pound coffee can with press-on lid.

**Tapping.** Here is one place that the can of fat more than pays its way. I fill the flutes and threads with solid fat by pushing the tap into the container. Then I go to work. As the tap heats up, the fat melts and eases the cutting. To tap a blind hole, pack the flutes with lard just about as solid as you can work it. Chips will imbed themselves in the fat and come out when the tap is backed off.

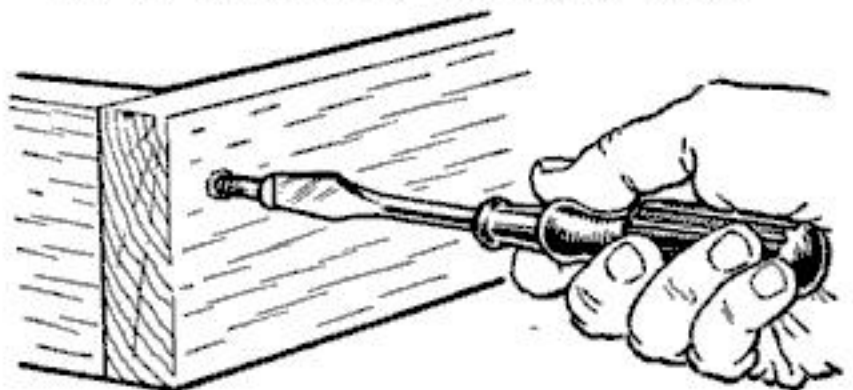


**Threading.** Dip the rod or bolt into fat before placing it in the die. Cut a few threads and force lard into the die cavities. It melts as the die advances.

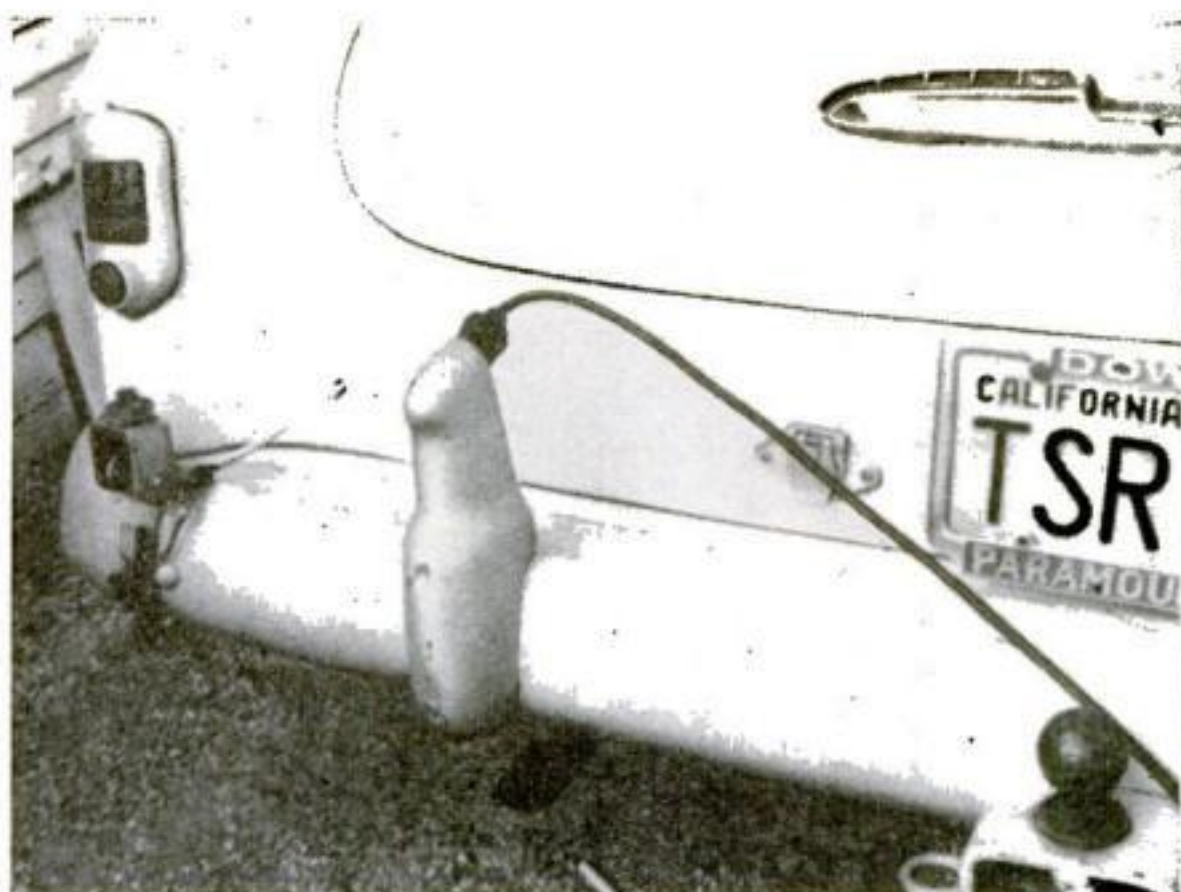
**Drilling.** Dip the drill into the fat to fill the flutes before you begin. For large or deep holes you can add extra fat with a spatula, if you find this is necessary.



**Driving screws.** Dipped in the fat, wood screws are easy to drive. The oils seep into the wood, keep screws rustfree. —F. P. Faltersack, San Jose, Calif.







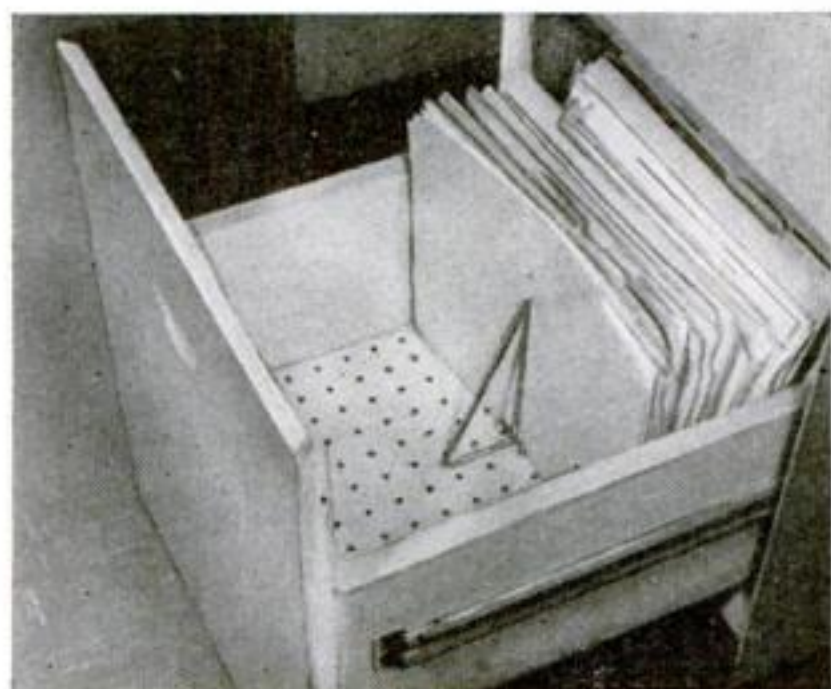
### Power socket hidden in bumper guard

A hard-rubber electrical socket mounted inside a rear bumper guard and connected to a hot wire of the car's electrical system gives me a convenient source of power when I work on my car. By plugging in a

trouble light, I get illumination over a large area. I also use the socket to light my trailer from the car battery. One end of a short electric cord is plugged into this outlet and the other into the entrance socket on the trailer.—*Jerome V. McGinn, Los Angeles.*

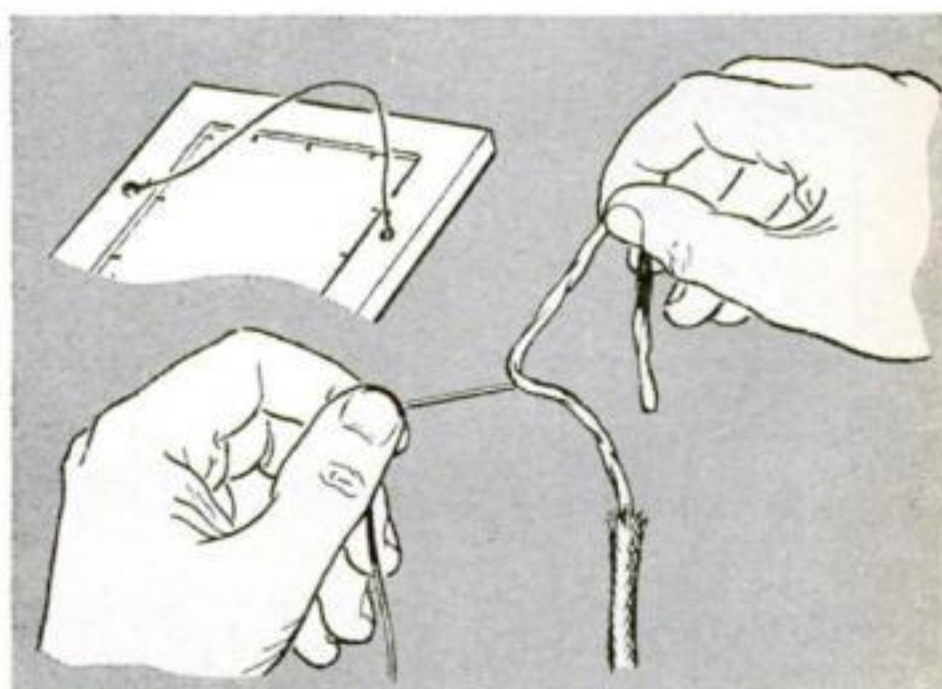
▶▶▶Finding it hard to heat my station wagon in cold weather, I rigged up a window-shade roller in back of the rear seat, using clear plastic so as not to obscure vision. When it is pulled down and snapped to the seat back, the passenger area heats up quickly.—*H. Richter, Detroit.*

▶▶▶When you saw out an opening in a plaster wall for an electrical junction box, the plaster tends to chip away. I have found that this can be lessened by outlining the cutting area with strips of masking tape. Pull the tape away after making the cut.—*Wilfred Beaver, Chicago.*



### Follower block for filing cabinet

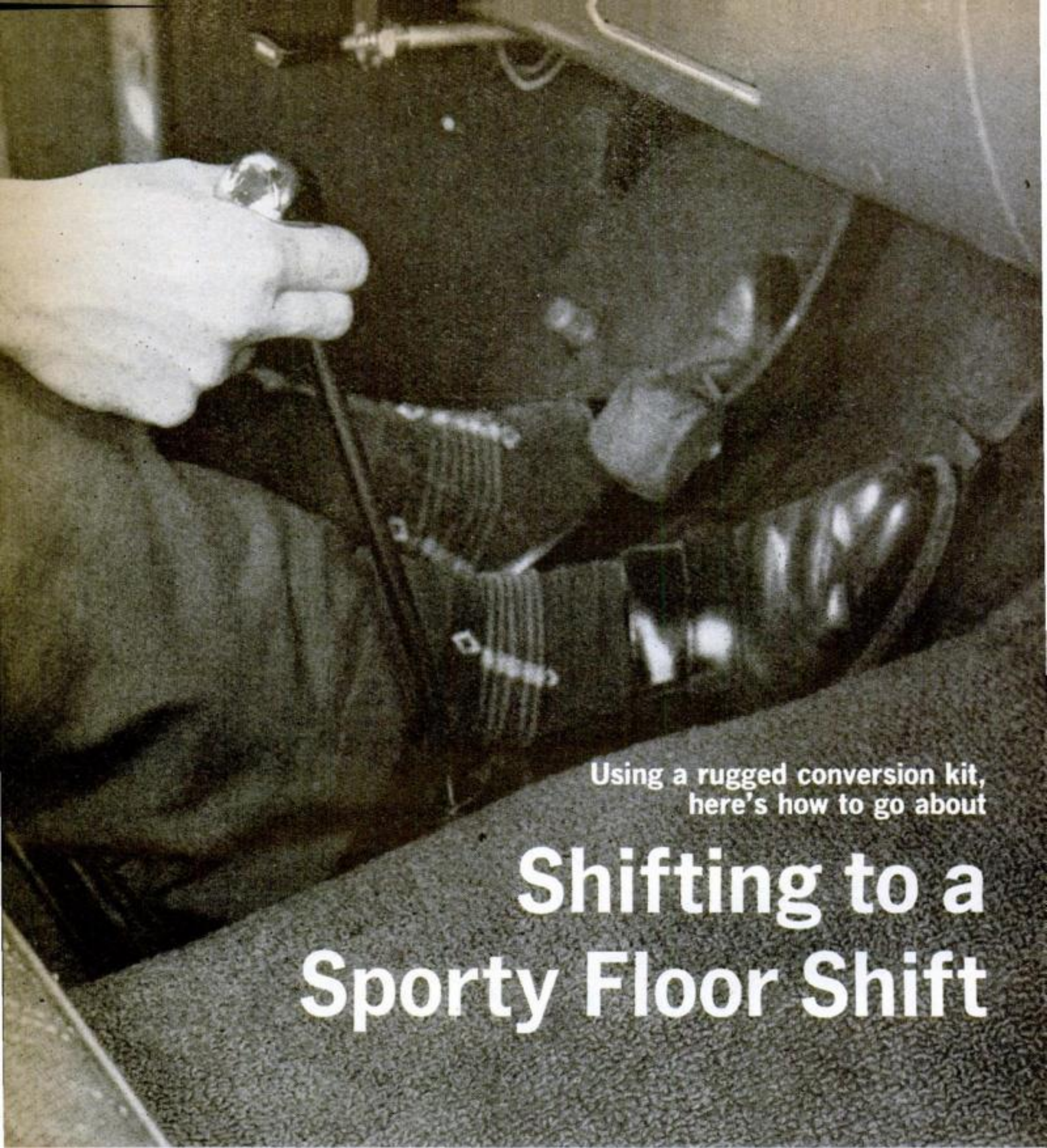
Perforated hardboard is the smart way to provide a positive follower block in a home filing cabinet. Cut the hardboard to drop into a metal drawer or make it the bottom of a wooden one. Use a perforated-board bookshelf bracket as above.—*W. G. Waggoner, Sacramento, Calif.*



### Picture wire from appliance cords

Discarded appliance cords are a good source of flexible wire for hanging pictures if you don't have the regular wire on hand. If available, a wire-stripping tool can be used to advantage. However, insulation usually strips free with little trouble.—*Michael Ligocki, Gary, Ind.*





Using a rugged conversion kit,  
here's how to go about

# Shifting to a Sporty Floor Shift

By Phil McCafferty

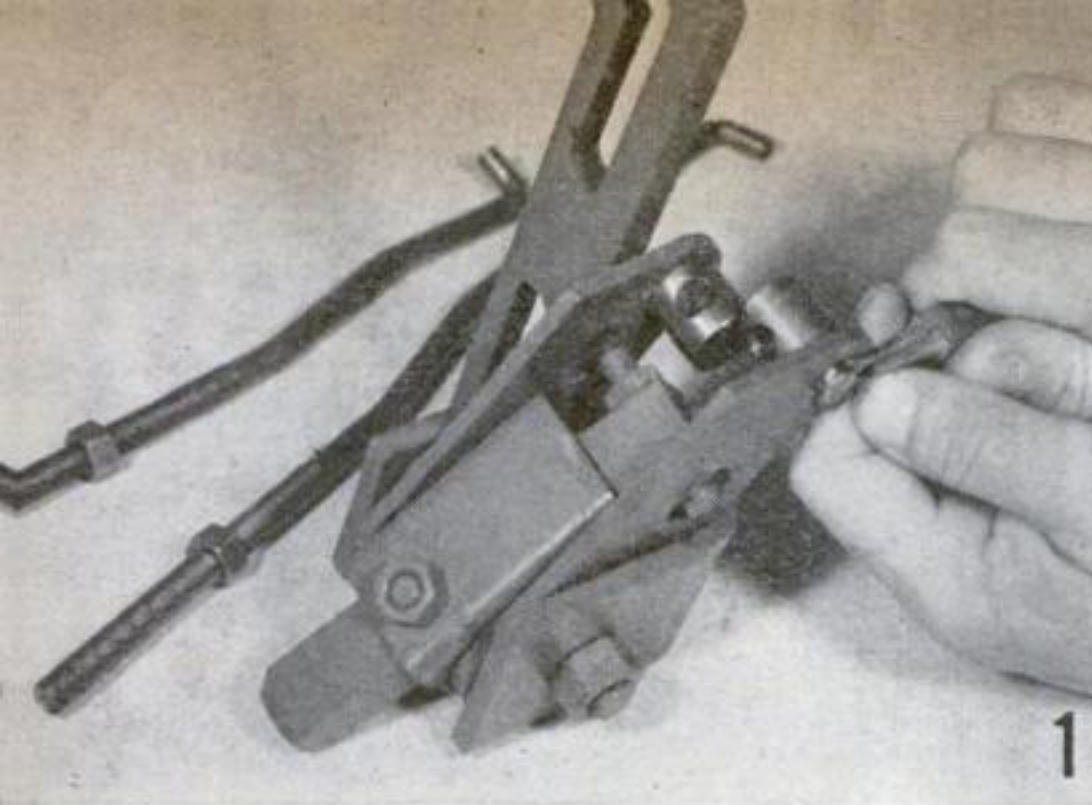
**A** GOOD part of the fun of the new '63 cars with sporty floor-mounted stick shifts can be yours without shelling out money for new transportation.

Now available for nearly all cars with column-shift transmissions is a floor-shift conversion unit. The fairly simple change-over can be made in an afternoon. The

result is a short-coupled, conveniently located stick that shifts just as crisply as any in a sports car. And after you stop reaching for the missing column lever in a day or so, it grows on you.

The floor shifts are available for both standard and automatic transmissions. They make the most sense on a standard, of course, but can be fun on an automatic even though you don't shift as often.





1



2

**1** Shifter comes preassembled except for the linkage parts. The rod links are inserted in holes in the shifter plates and held by retaining rings forced into grooves with pliers. A washer goes between each link and its plate.

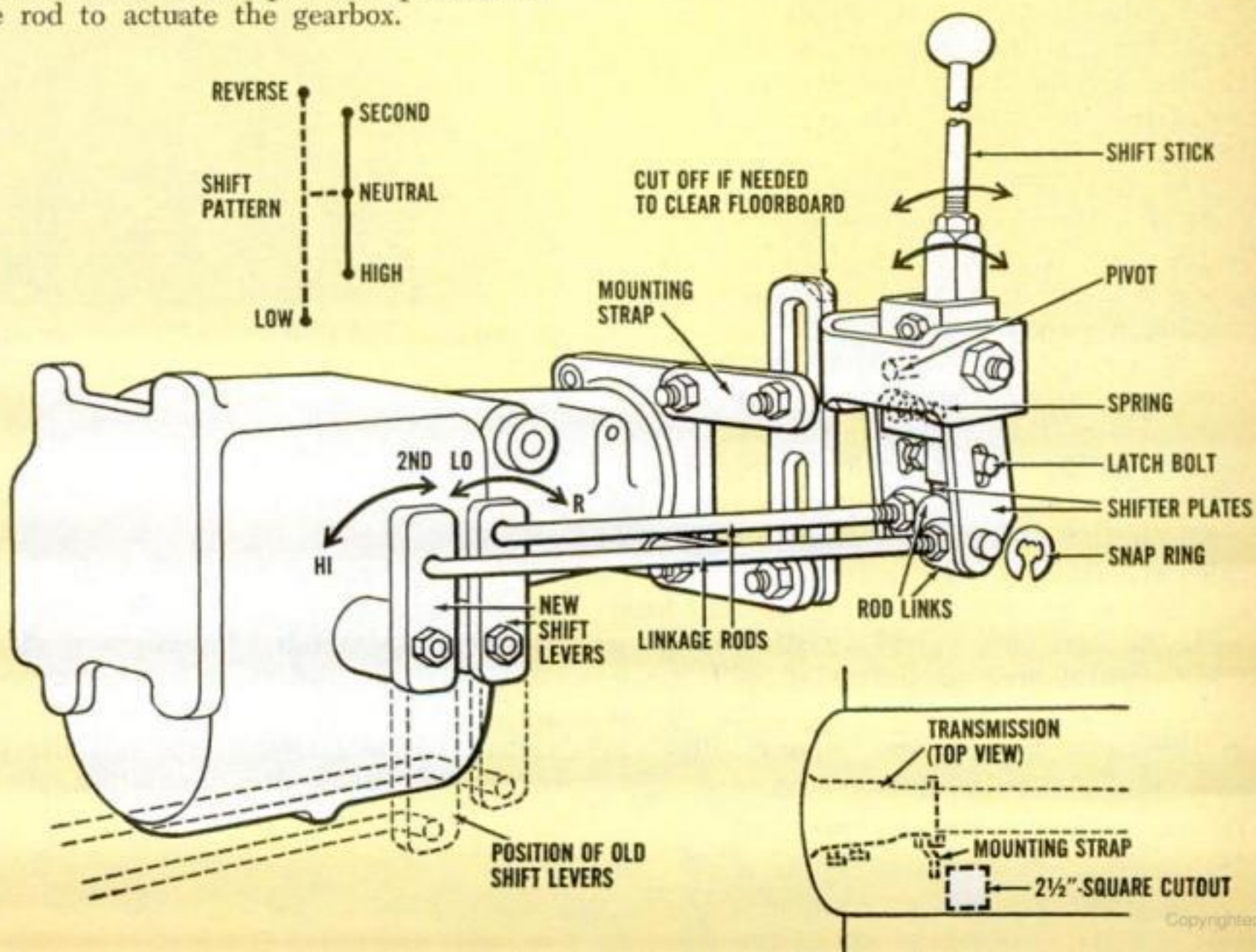
**2** Remove the lower rear bolt (or nut) on the transmission and put on one mounting strap. It should extend straight out. Sight directly upward from hole in end of strap and center-punch a mark in bottom of the floorboard.

**3** With transmission in neutral, remove cotter pins and linkage from existing shift levers. Then remove levers themselves and replace them with the new levers supplied. The levers should point straight up in the neutral position.



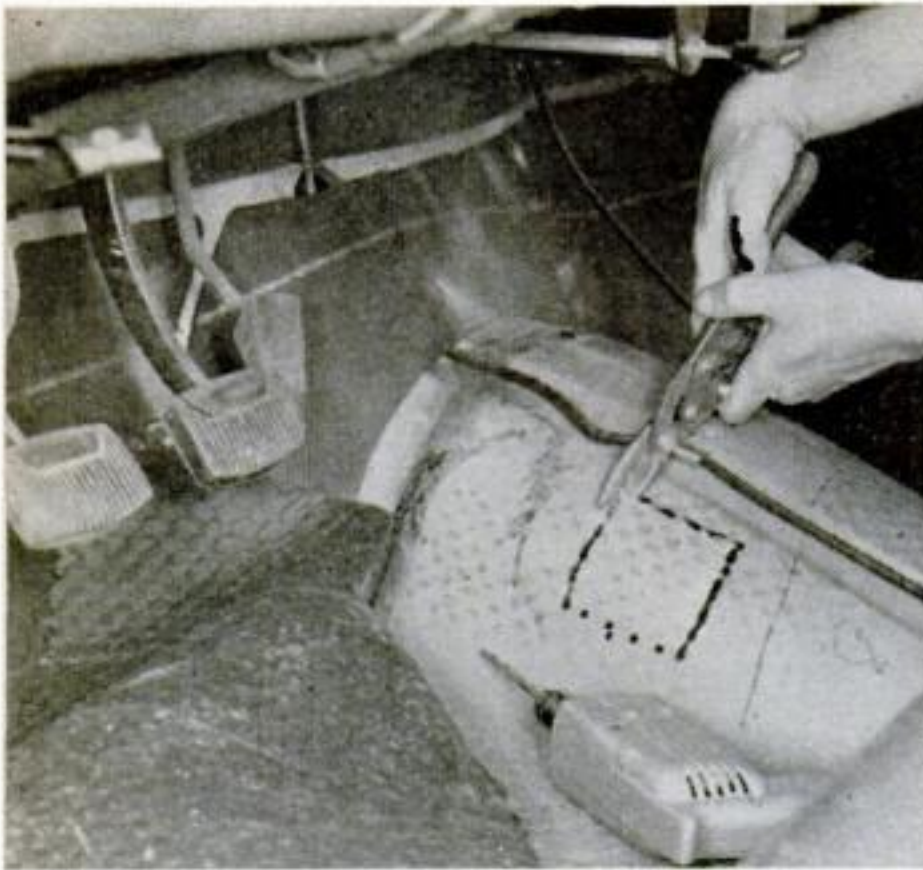
3

New floor shift mounts on existing transmission bolts and is connected to the shift levers by rods. Moving the shift stick sideways swings the latch bolt so it engages either shifter plate. Moving the stick forward or back then pushes or pulls either linkage rod to actuate the gearbox.





## How the new stick shift is installed through



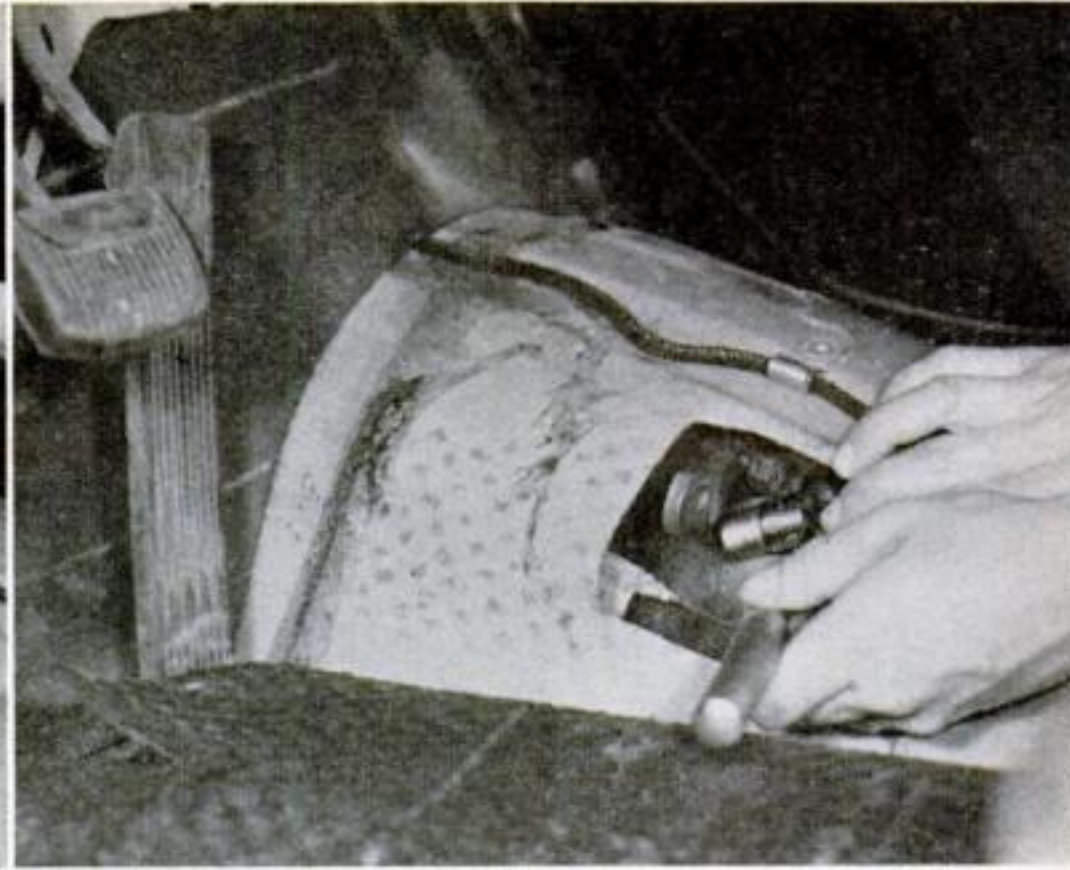
**4** Take up the floor mat and find the mark made by the centerpunch in step 2. Mark a  $2\frac{1}{2}$ " square on the floorboard with the mark at the forward corner nearest the transmission. Drill a series of holes around the square and snip out the piece with heavy shears.

If you buy the conversion pieces separately, the cost is about \$27. This covers the mechanism, a chrome-plated stick, and knob, but not a flange to cover the joint between the boot and floor mat. Complete kits, including a neat flange, run from \$30 to about \$35, depending on the car make. The parts and kits are available from many local auto-supply and speed shops, and by mail from J. C. Whitney & Co., 1917 Archer Avenue, Chicago. (If your car has overdrive, tell them! The parts are different.)

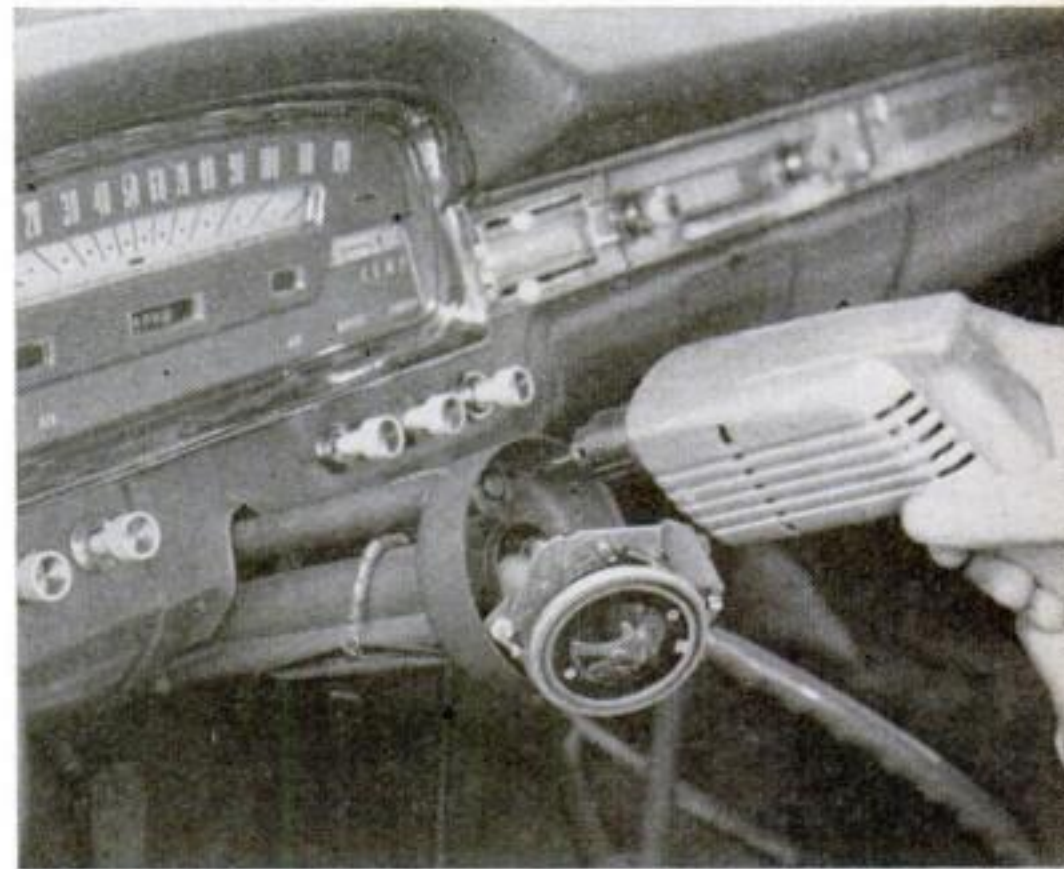
*The good old days.* The conversion floor shift is a lot nicer than those I remember in the days when all cars had them. Placement of the shift lever is surprisingly good, making it easy to use.

The short 12" stick conveniently nestles back and along the driver's side of the transmission tunnel unlike the high, centered position of the oldtimers. Shifting is fast, quiet (no linkage slop or noise), and crisp—at the shifter knob scarcely 5" separates second and high gears.

In those good old days you had to hunt with the end of a yard-long stick across a wide neutral area to shift in the "H" pattern. The conversion unit is spring-loaded in the same manner as column shifts for fast, sure speed-changing.



**5** Mount the upper mounting strap on the top transmission bolt by working through the hole in the floorboard. Lower the shifter assembly down through the hole and bolt it to the upper mounting strap through the slotted hole. Leave the bolt loose temporarily.

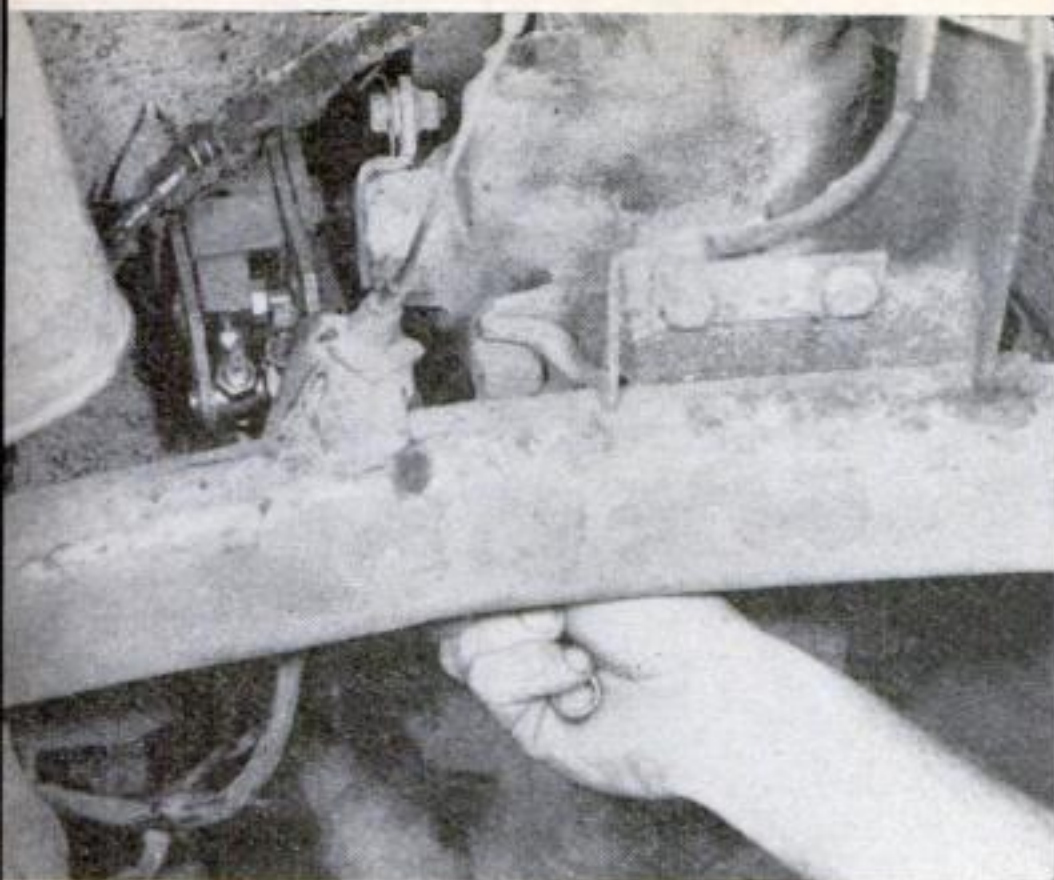


**7** Remove old linkage at base of steering wheel. Tube on top of steering column (exposed on some cars) can be removed by drilling out the spot welds under the horn that hold the upper end. Or you can take off just the lever by driving out the pin at its base.

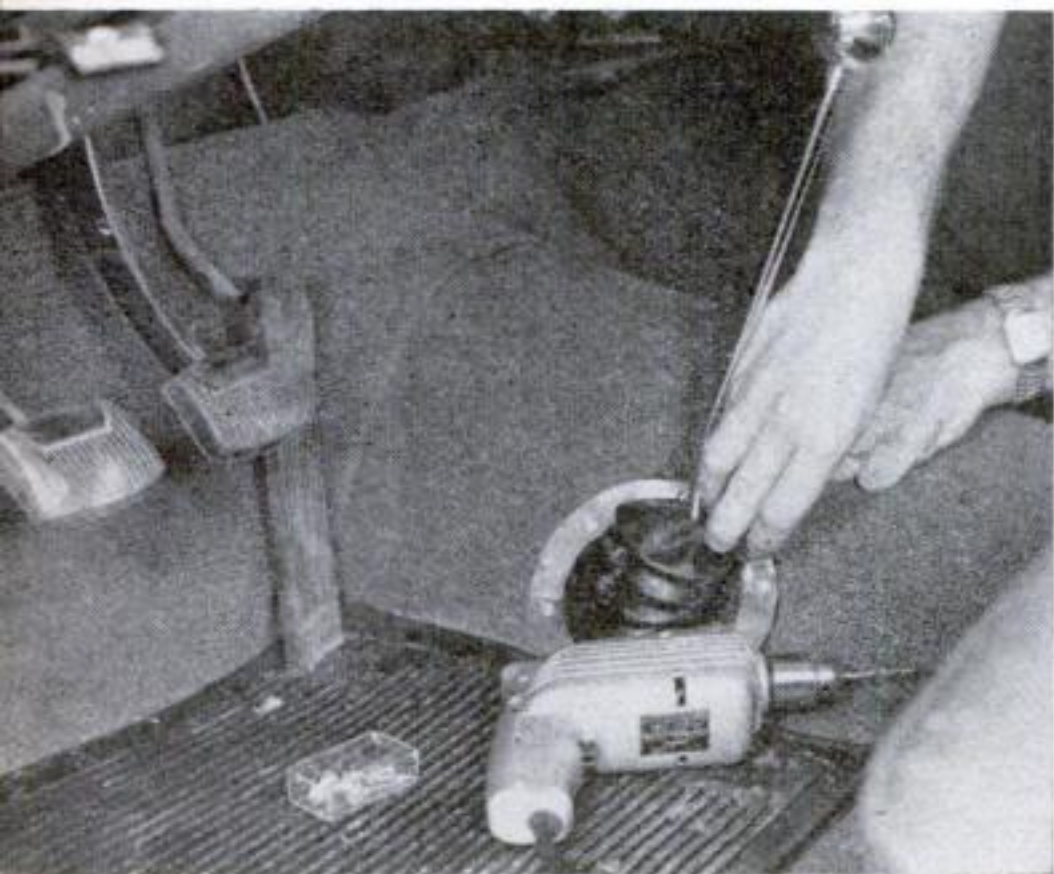
*The mechanism is rugged,* but suffers from machining and punching burrs. You can save yourself trouble when working in close quarters under the car by deburring the parts before you start. In some cases, it may be necessary to saw off the upper corner of the shifter mounting strap to



## the floor of the car



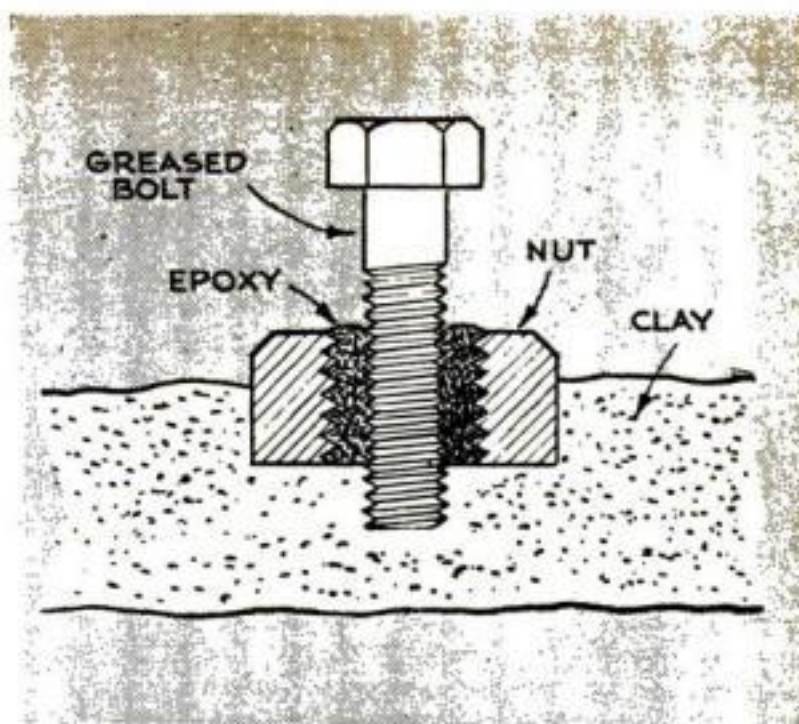
**6** Fasten lower mounting strap from underneath. Insert threaded ends of linkage rods into rod links and secure other ends to shift levers with cotter pins. Adjust nuts on the rods so the latch pin is free to enter both shifter plates. Finally, tighten all nuts.



**8** Slit the floor mat in shape of an X where the shift stick projects. Slickest way to fasten the flexible boot is with a metal flange, either bought with kit or made yourself from aluminum or stainless steel. Where no flange is used, tuck the boot under the mat.

avoid any interference with the floorboard.

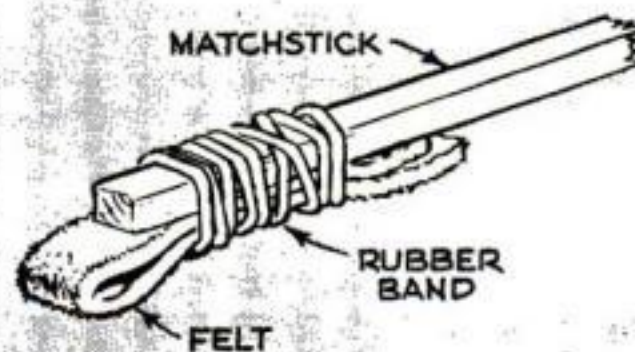
Underneath work can be done by sliding under the car, but it's a lot easier and safer if you can persuade your local service station to let you use its grease lift for a couple of hours for the down-under part of the job. ■ ■



### Nuts molded from epoxy cement

The next time you can't find a nut to fit a special bolt, try making your own by filling an oversized nut with epoxy cement and molding the threads. Seat the nut in modeling clay before pouring in the epoxy. Grease the bolt, then screw it down through the epoxy into the clay. Wait a day, unscrew the bolt from the hardened epoxy, and you'll have a perfect-fitting nut for moderate duty.—*P. L. Holden, Richardson, Tex.*

▶▶▶ Whenever I'm out at night walking my dog along the road, I find it a wise precaution to carry a light walking stick wrapped with red reflective tape, barber-pole style. This makes it much easier for motorists to spot me in the dark and avoid a possible accident.—*Michael Bernhard, Roslyn Heights, N. Y.*



### Quickie poster pens from old felt

It costs nothing to have a whole supply of felt pens for lettering signs and posters. Cut narrow strips of felt from an old hat, fold them in two, and fasten them to small sticks with rubber bands. For extra stiffness, old pen nibs can be inserted in the folds. Use a different brush for each color and there's no mess.—*Jack W. Frazier, Shreveport, La.*



# A Simple Bending Brake for Home Shops

By John E. Turner

**P**UTTING clean, crisp bends in sheet metal is a job for a bending brake. The one shown here is patterned after professional brakes, but can be made from a length of two-by-four to give you an accurate metal-bending tool for home-shop use.

While simple in design, the brake provides for the precise adjustments that are the secret of sharp bends. Like its commercial cousin, it works by using a hinged leaf to force the metal up and around a sharp-edged lip. It will handle such metals as aluminum, tin plate, and galvanized iron in thicknesses up to 26 gauge when the pieces run the full width of the brake. On narrower pieces, it will easily bend heavier-gauge sheets.

The parts for the brake can be cut from an ordinary fir two-by-four, although a hardwood such as oak is even better. The lip block is sawed at a 45-degree slant. Cut a piece 23" long, then slice off two 2" sections. This will give you a 19" length for the lip itself plus the two short spacers that support the lip.

The lip edge is rabbeted  $\frac{1}{8}$ " by  $\frac{3}{4}$ " as shown. The rabbet enables you to screw in a strip of  $\frac{1}{8}$ " aluminum or steel to keep the wood edge from wearing. Similar rabbets in the leading edges of the leaf and base are also fitted with metal strips. The strips can be removed and replaced if they become worn themselves.

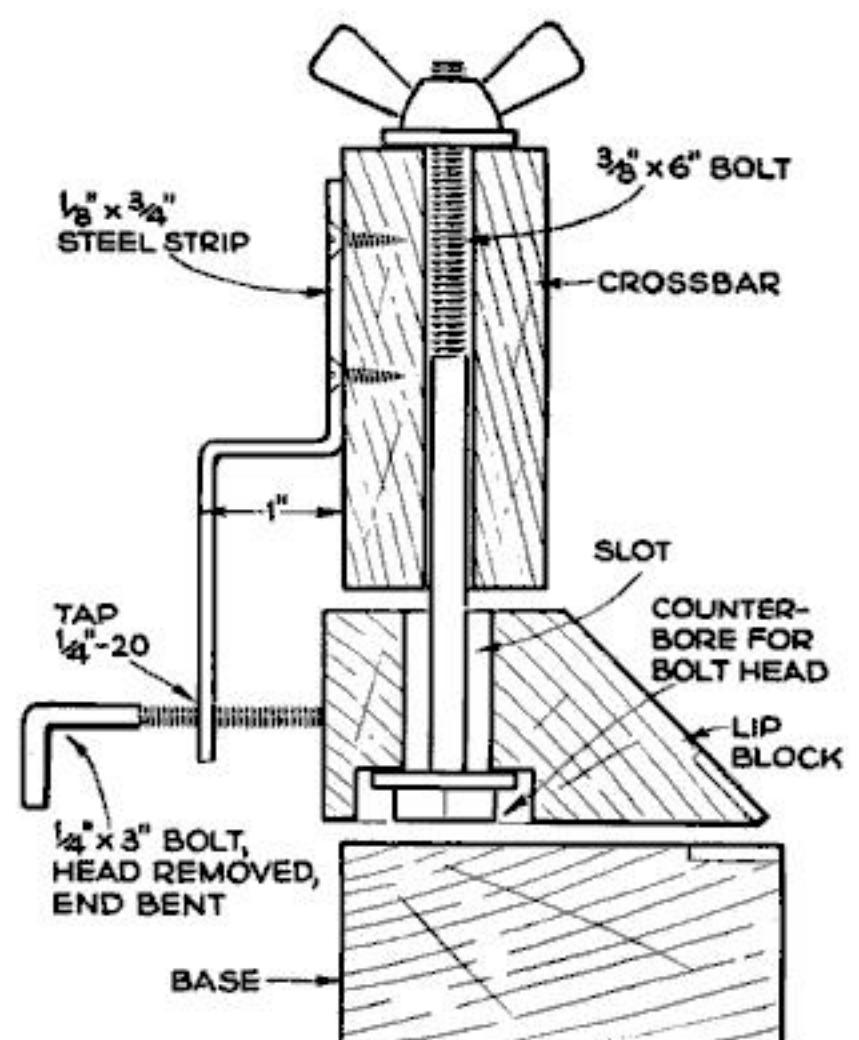
The lip block is held by a crossbar that rests on the spacers at the ends. Bolts extending through the crossbar, spacers, and base hold the assembly together. Counter-bore the base to recess the bolt heads.

*The lip is adjustable.* As in professional brakes, the lip block can be shifted both

up and down and forward and back to suit the thickness of metal being bent. Thin shims inserted under the lip crossbar adjust its height. Slotted holes in the lip itself enable you to vary the gap between the lip and the bending leaf.

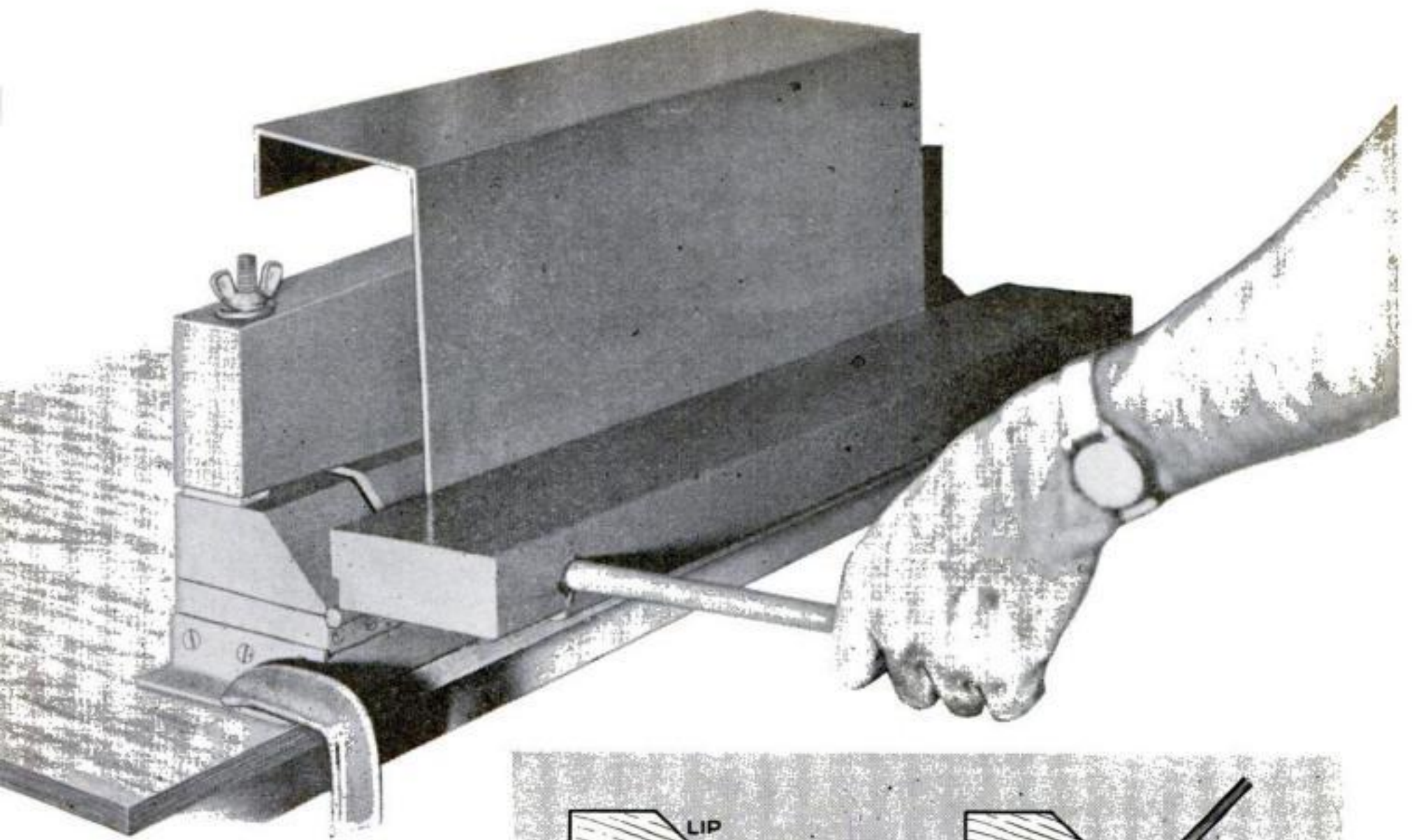
Two metal brackets are bent as shown and the upper ends screwed to the rear of the crossbar. The lower ends are drilled and tapped for  $\frac{1}{4}$ "-20 adjusting screws that bear against the back edge of the lip block. By turning the screws in or out, the lip can be advanced or retracted as needed to set the proper gap at the leading edge. The

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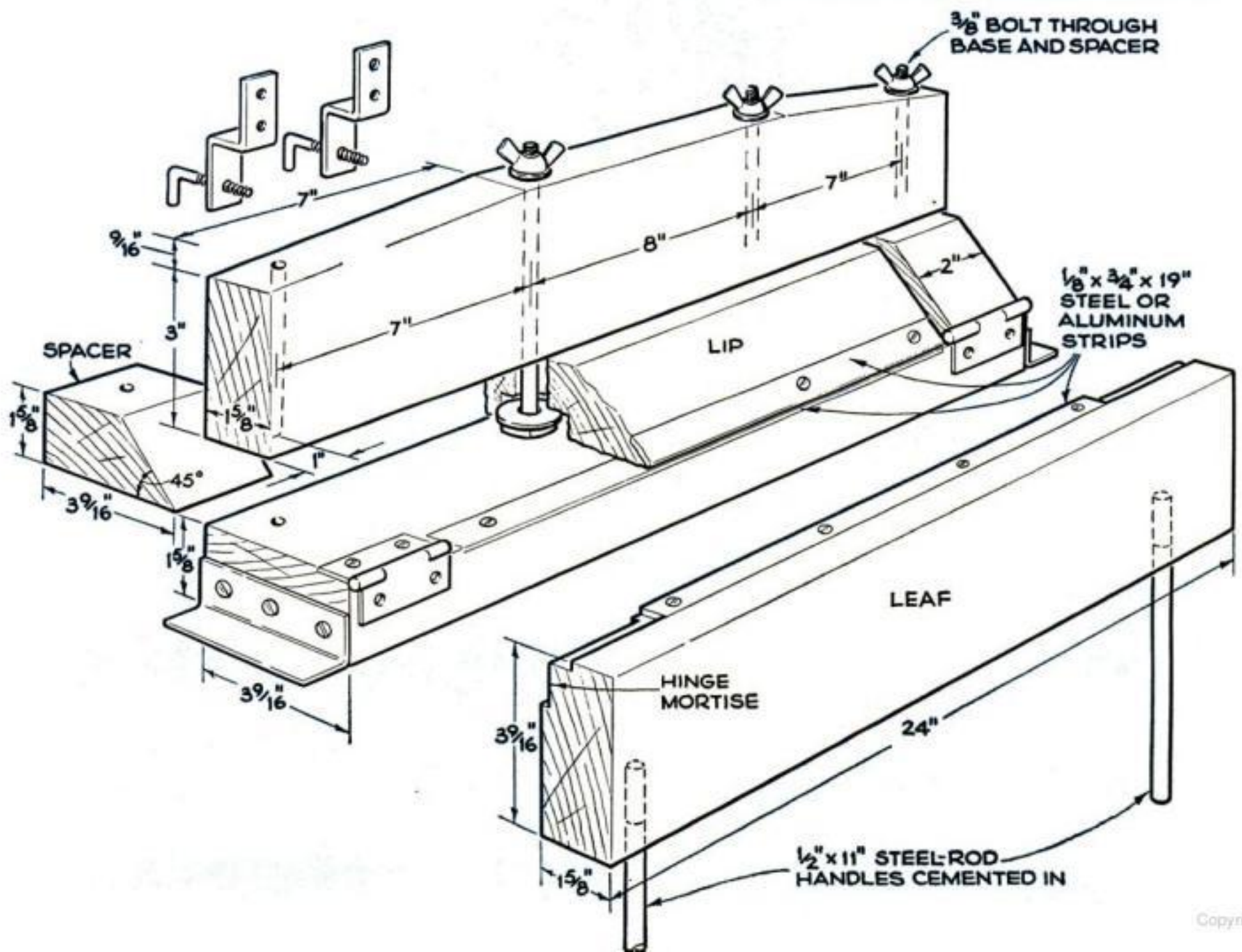
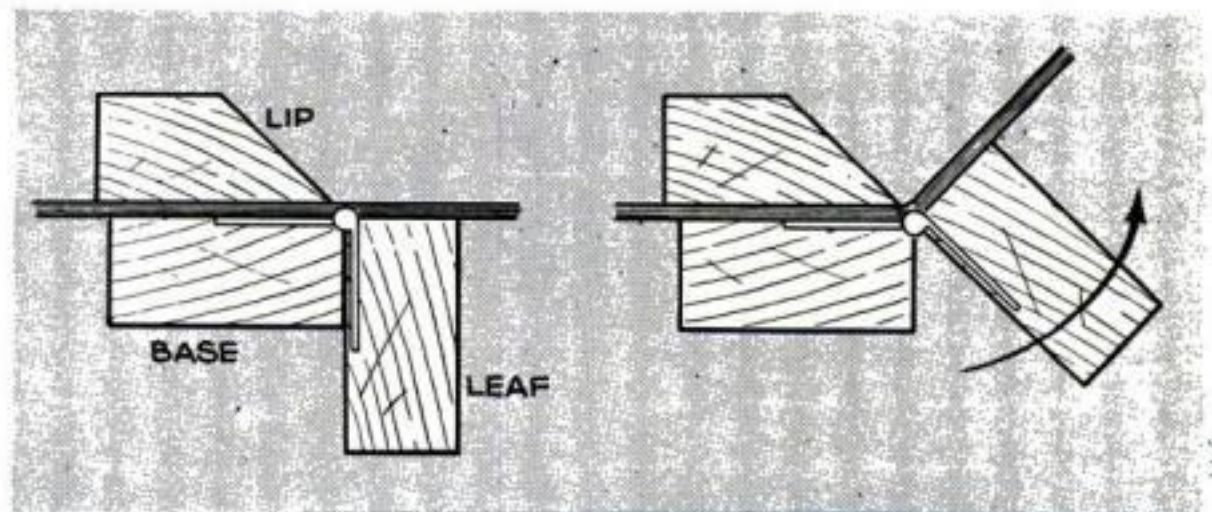


Slotted holes let the lip move forward or back. To locate these, assemble the brake and slip in the lip so its rear overhangs the base about  $\frac{1}{8}$ ". Drill through the crossbar holes into the lip; then remove the lip and drill on each side of each first hole. Chisel out the waste to join each set of three holes into a slot.





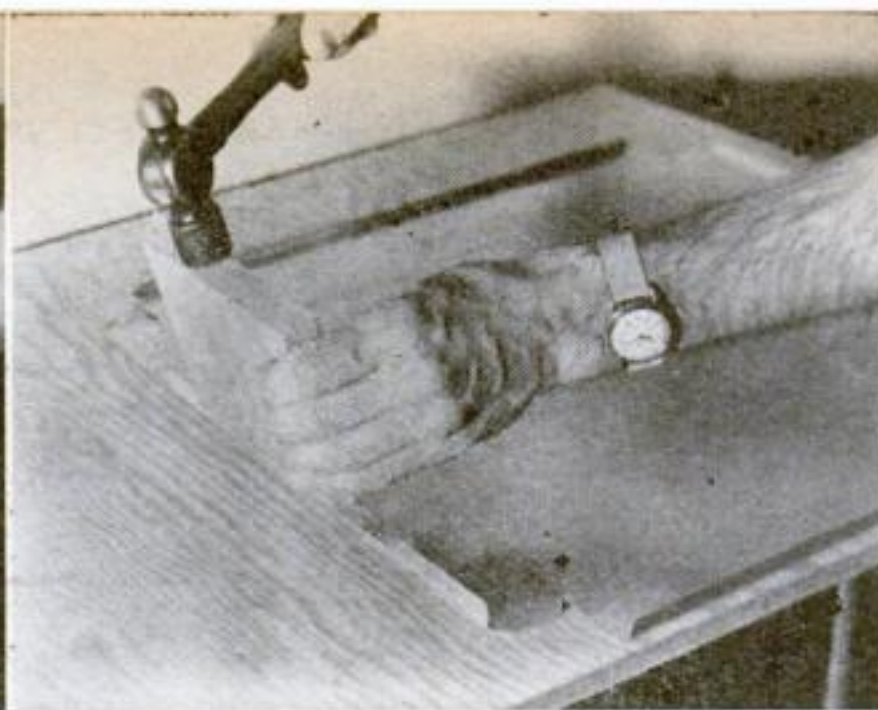
Pull the hinged leaf up, and in a single motion you get a clean, sharp bend. The metal is clamped snugly in the brake by simply tightening two wingnuts.







**Adjust thin shims** under each end to give firm clamping pressure but still leave a gap under the lip. This makes it easier to slide the metal in and out when pressure is released.



**Full bends** are started in the brake, then crimped the rest of the way over by hammering a wood block. This is an easy way to make tight lap joints and smooth metal edges.

tapered shoulders on top of the crossbar are just for looks—they give the brake a more professional appearance.

Hinging the leaf block to the base is about the only critical operation. The hinge leaves must be carefully mortised into the edges so that their axis of rotation lies exactly at the point where the leaf and base meet. This assures that the leaf will swing up at a uniform distance from the lip for a smooth, tight bend. One helpful trick is to buy hinges that have removable pins. Take the hinges apart, reverse one leaf in each, and reinsert the pins. This puts both hinge leaves in the correct position for countersinking the mounting screws.

The brake can be fastened to a bench top with two short lengths of steel or aluminum angle screwed to the ends of the base. For permanent mounting, the angles can be bolted to the bench, but you'll probably find it handier to use C clamps so the brake can be removed quickly when not in use.

**How to use the brake.** The metal to be shaped is slipped under the lip until the amount you want bent projects beyond the lip edge in front. The radius of bend can be controlled, to some extent, by shifting the lip forward or back. The closer it is to the leaf, the sharper the radius; the farther away, the more gradual. In any case, the lip should be set no closer to the leaf than the thickness of metal being bent. This allows clearance for the metal between the lip and the leaf.

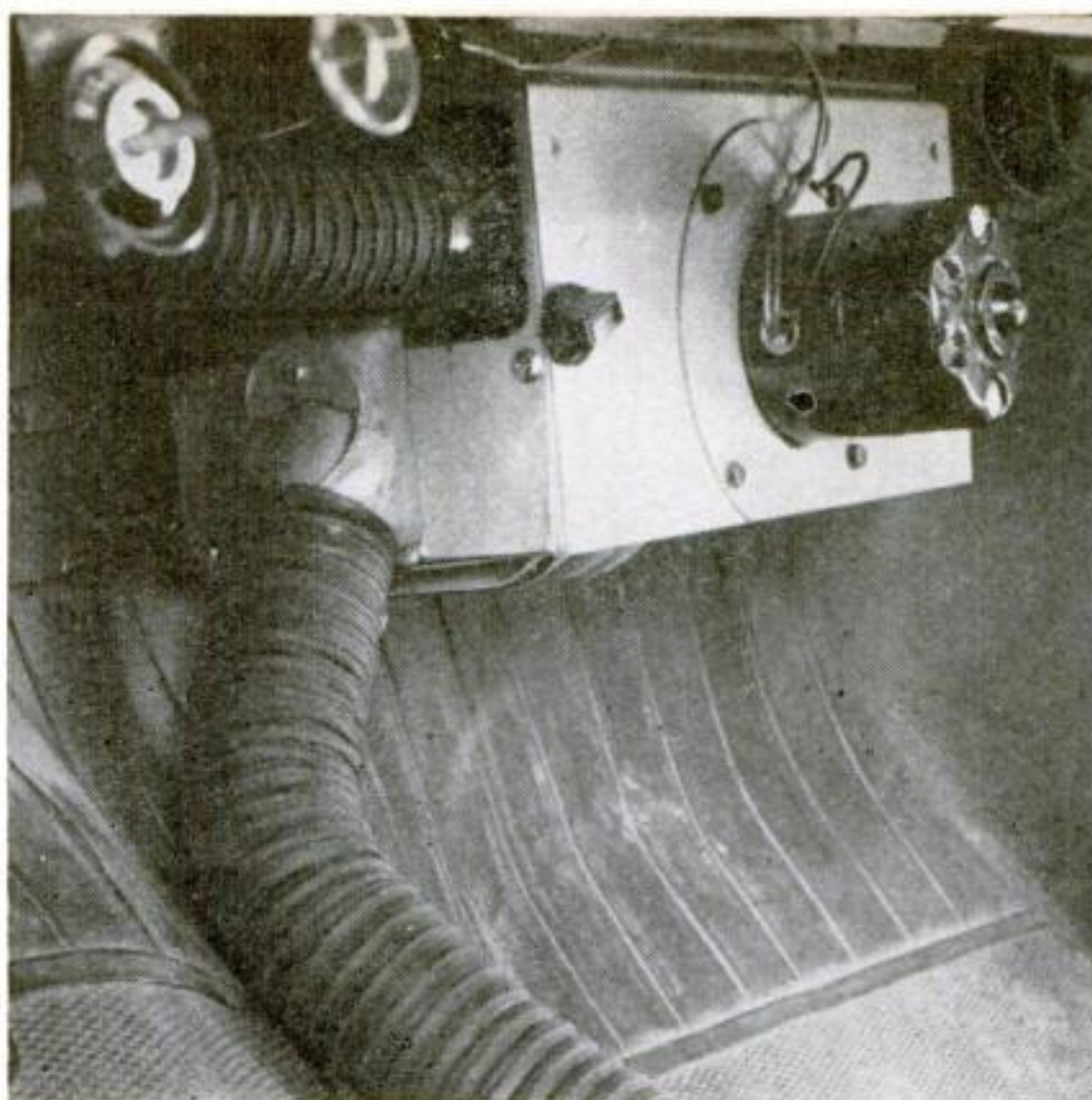
Square the metal carefully to the lip, then tighten the wingnuts at the ends of

the crossbar. This clamps the lip snugly down against the metal to hold it. For 90-degree bends, you'll find it necessary to swing the leaf a little past vertical to allow for spring-back of the metal. To crimp an edge all the way over, force the leaf as far as it will go against the lip; then remove the piece and finish flattening the bend with a wood block and hammer. It's wise to hem all exposed edges in this way to get rid of rough metal. Remember, though, to do this hemming first, as the edges can't be crimped after other bends have been made. It's best not to attempt bends closer than  $\frac{1}{4}$ " to  $\frac{5}{16}$ " to the edge or the metal may slip under the lip.

**Bending complicated shapes.** When you're making four-sided shapes, such as a tray, you'll find that one pair of sides gets in the way of the lip as you turn the object to bend the other pair. Here, you'll need two sizes of lips. First bend the two longest sides on the regular full-length lip. Then make a new, shorter lip block that will fit in between the two bent-up sides. This will now let you bend up the other two sides. Various lengths of lips can be made up as needed and mounted on the crossbar with the same bolts that hold the regular lip.

Where you want to fasten the sides of a tray or box together, leave small projecting tabs on the ends of the parts that are to be bent. These tabs can then be bent to engage the adjoining sides and riveted to them for a strong assembly. You can even make such joints watertight by simply running beads of solder down the inside. ■ ■



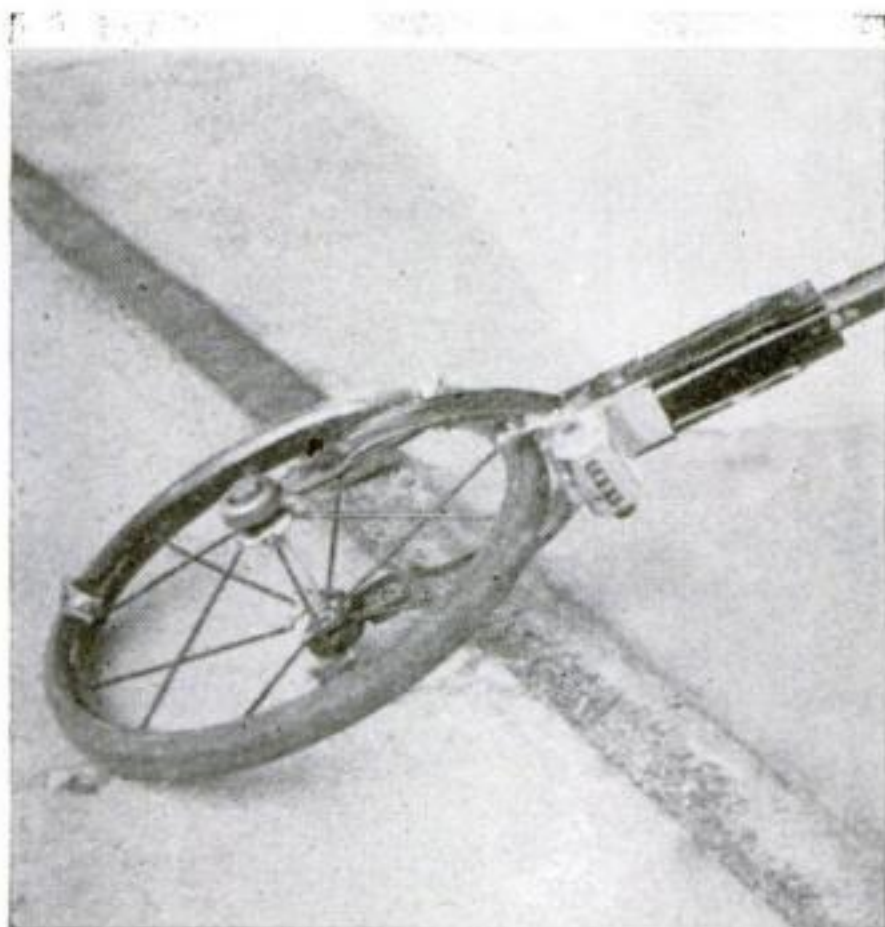


## Short Cuts and Tips

FROM  
PS  
READERS

### More heat for the feet of back-seat passengers

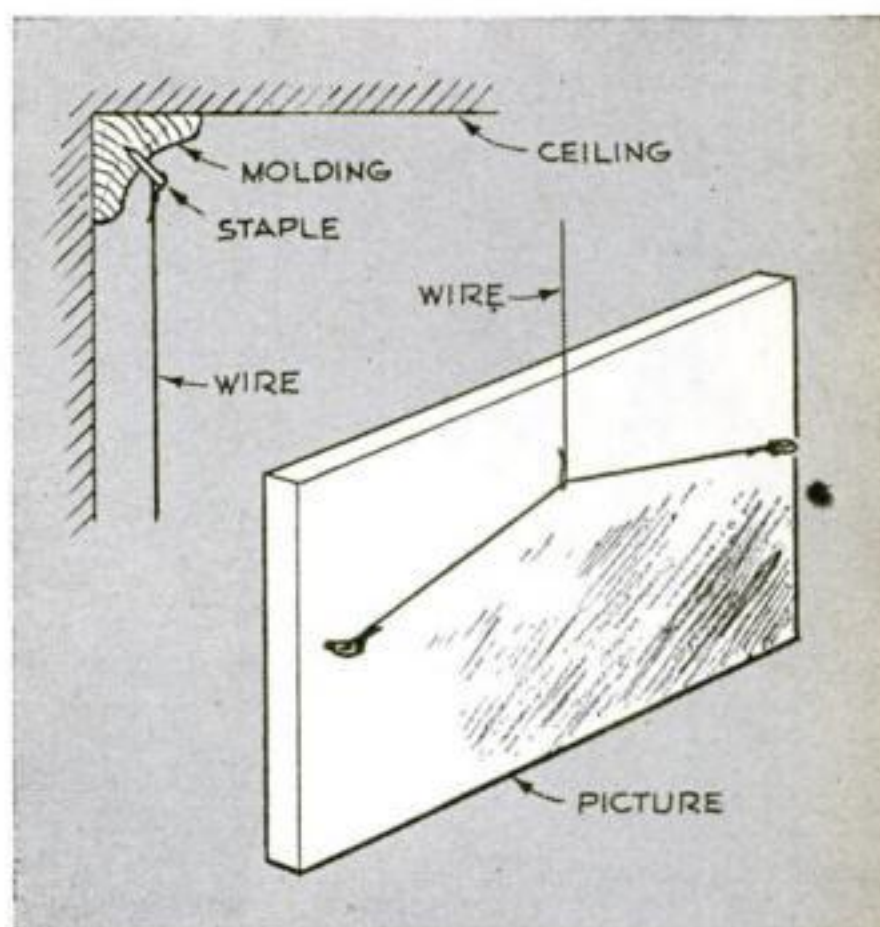
Many car heaters have an adjustment on the left side to heat the driver's feet. I blocked this off with a piece of sheet metal after cutting a hole in the sheet to take the heater end of a defroster fitting to which I attached a length of heater hose. I ran the hose along the transmission tunnel back to the rear seat. Now passengers at the rear get heat without the driver burning his feet.—K. J. Krausse, Rockville, Md.



### Homemade device to measure distance

Here's an efficient gadget for measuring distances. Materials: a wheel from a baby carriage, a broom handle, and an automatic counter—available from many surplus stores for about a dollar.

Most baby-buggy wheels are 36" in circumference. Attach three metal flanges at exactly 12" intervals around the rim to trip the counter three times on each rotation. Bolt the counter to the handle. Just roll the wheel to measure any distance.—E. M. Leffert, Whitefish Bay, Wis.



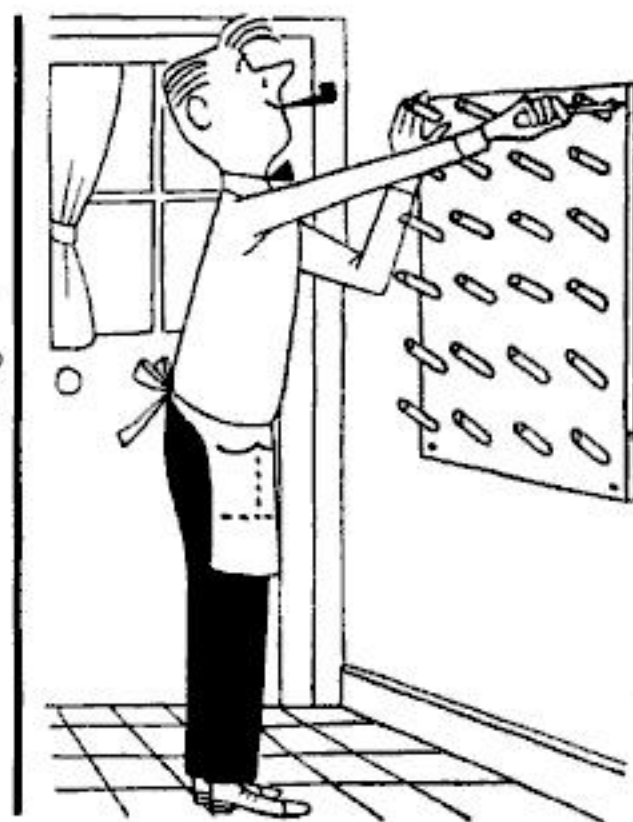
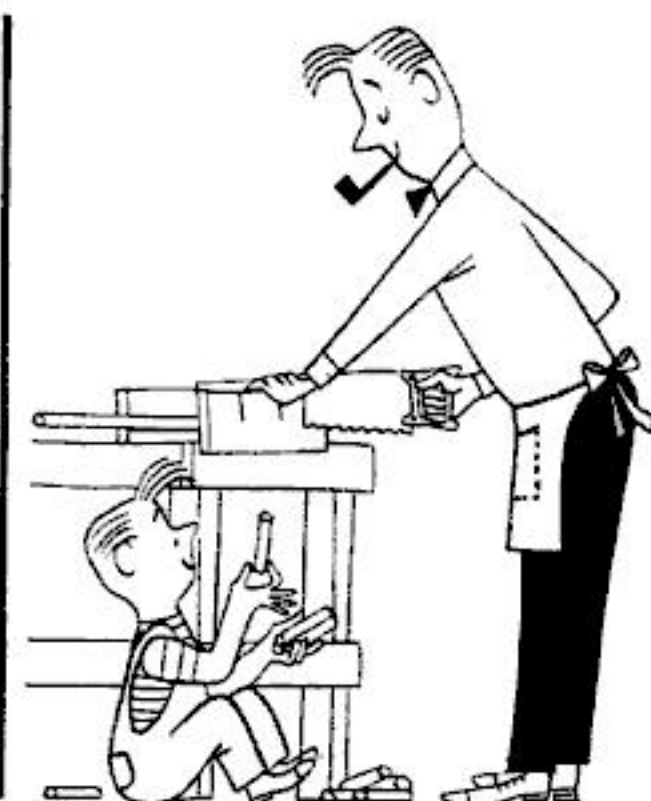
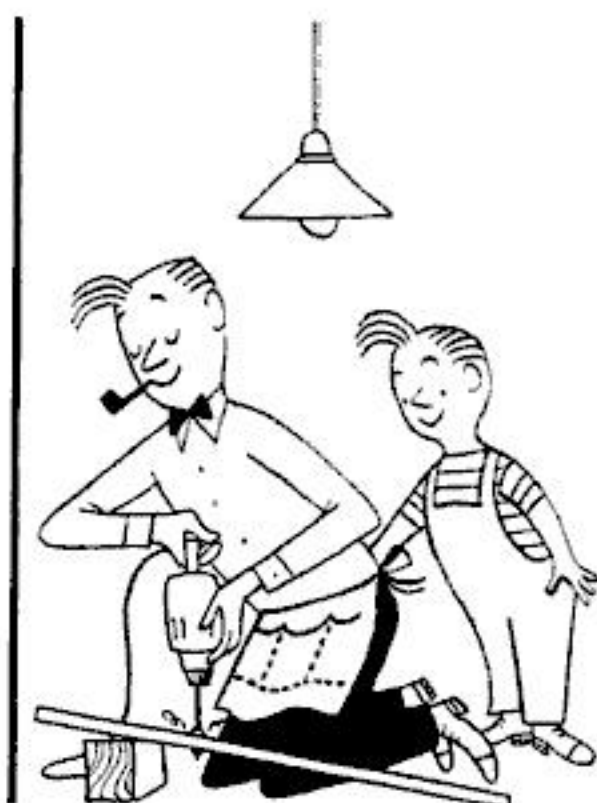
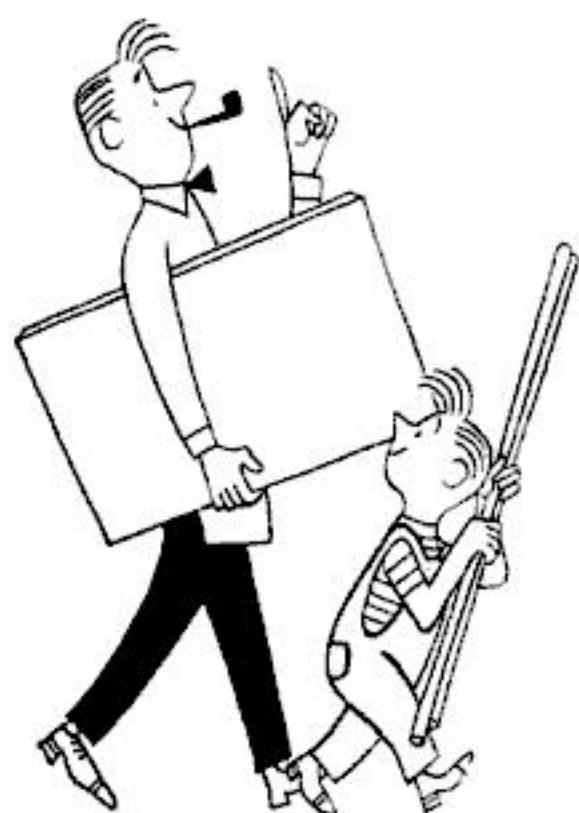
### No-mar method of hanging pictures

I have found a quick and convenient method of hanging pictures in my office and home without marring the walls. A heavy-duty staple gun is used to set a staple into the molding as close to the ceiling as possible. The staple usually does not penetrate the wood completely and a wire can be passed under it. This wire is then dropped to the point where the picture is desired—and attached to the regular wire across the back of the picture.—Dr. Stephen Fromer, Staten Island, N. Y.

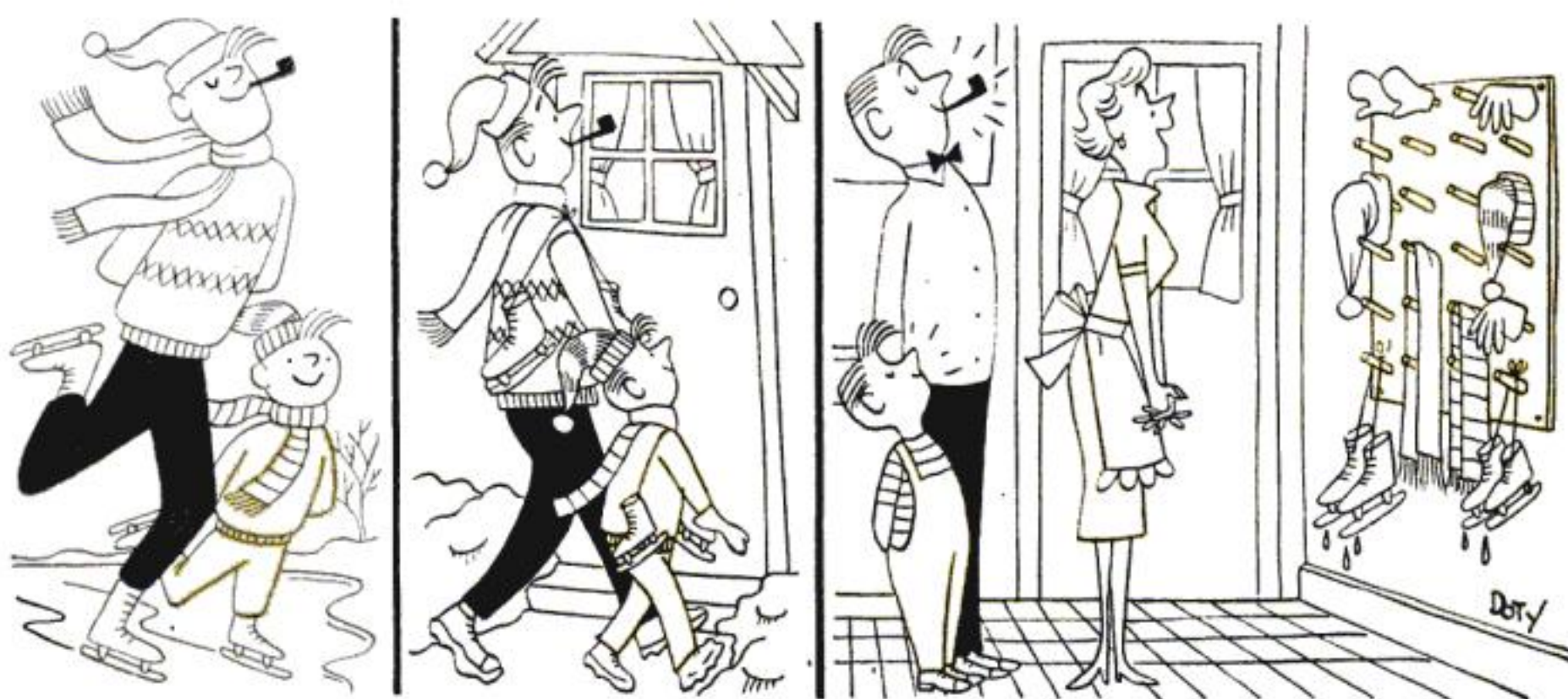


# Wordless Workshop

By Roy Doty  
and Morris Hornik

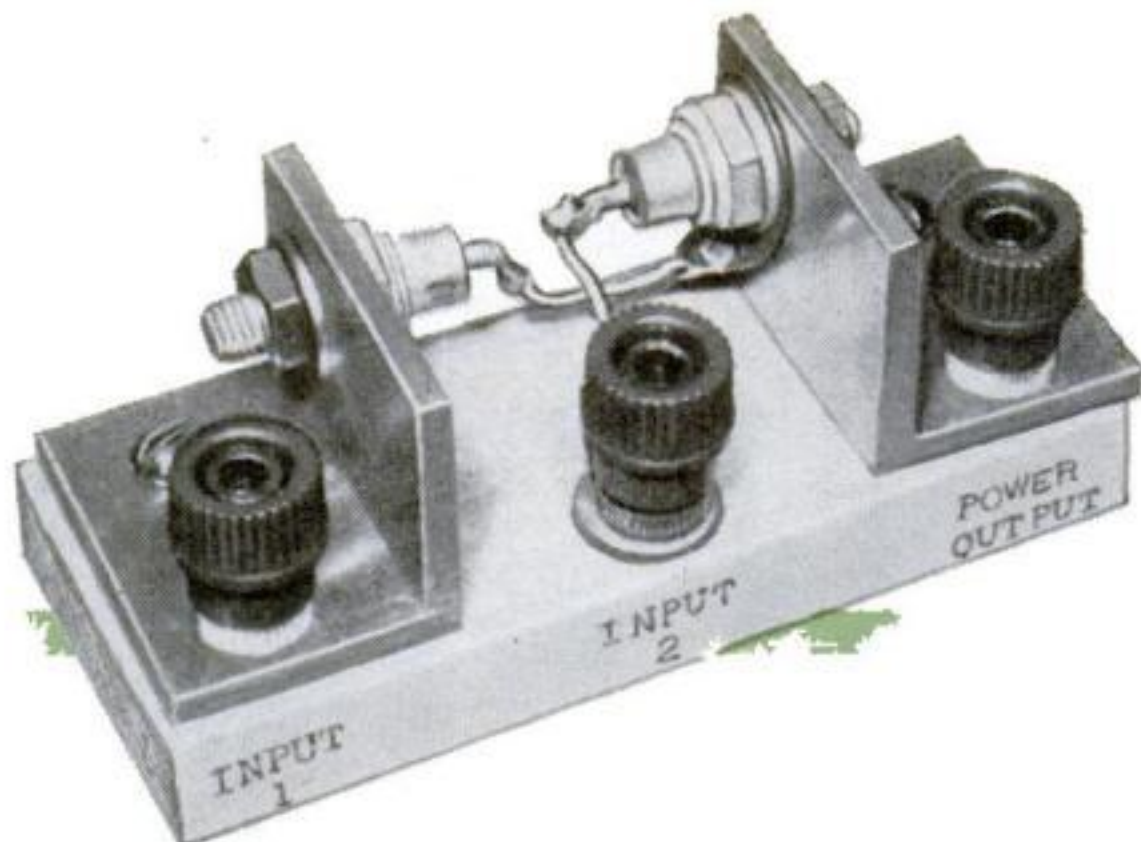








# trains, different speeds,

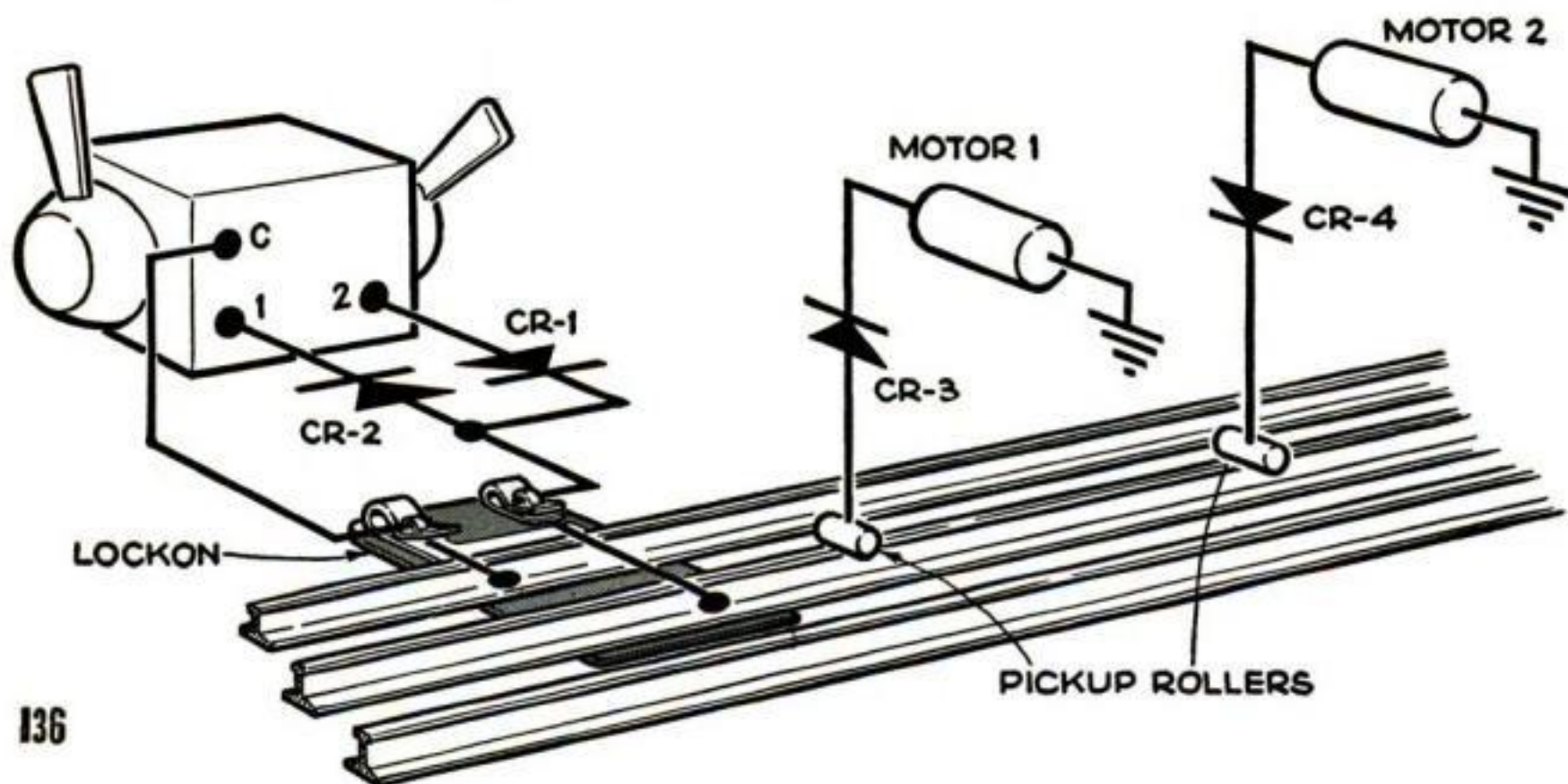
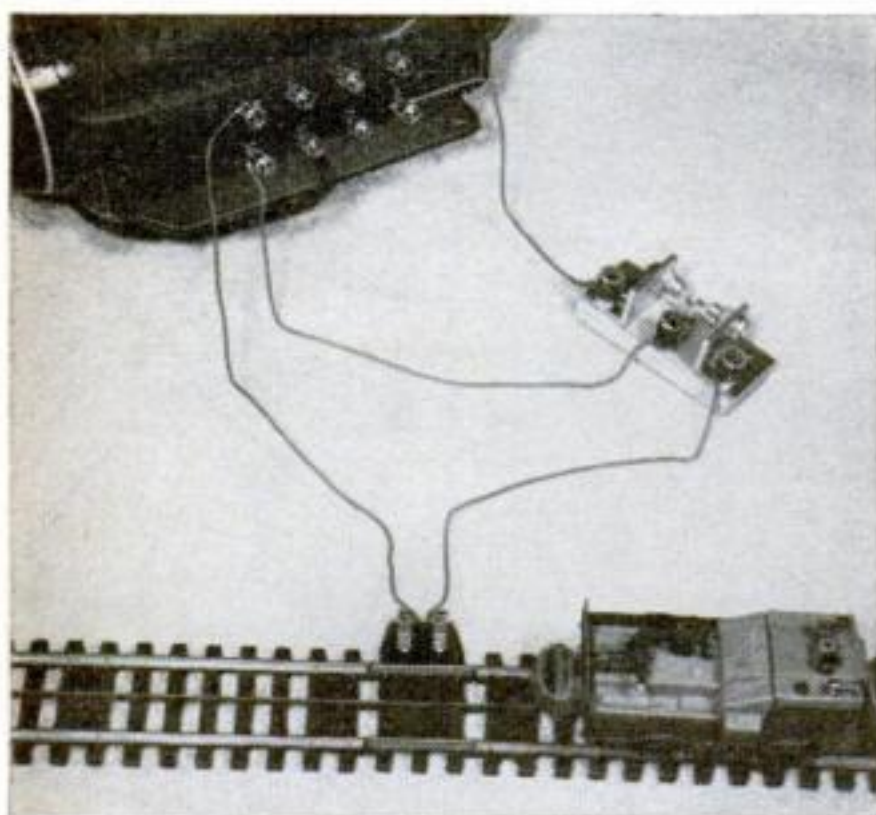


# track

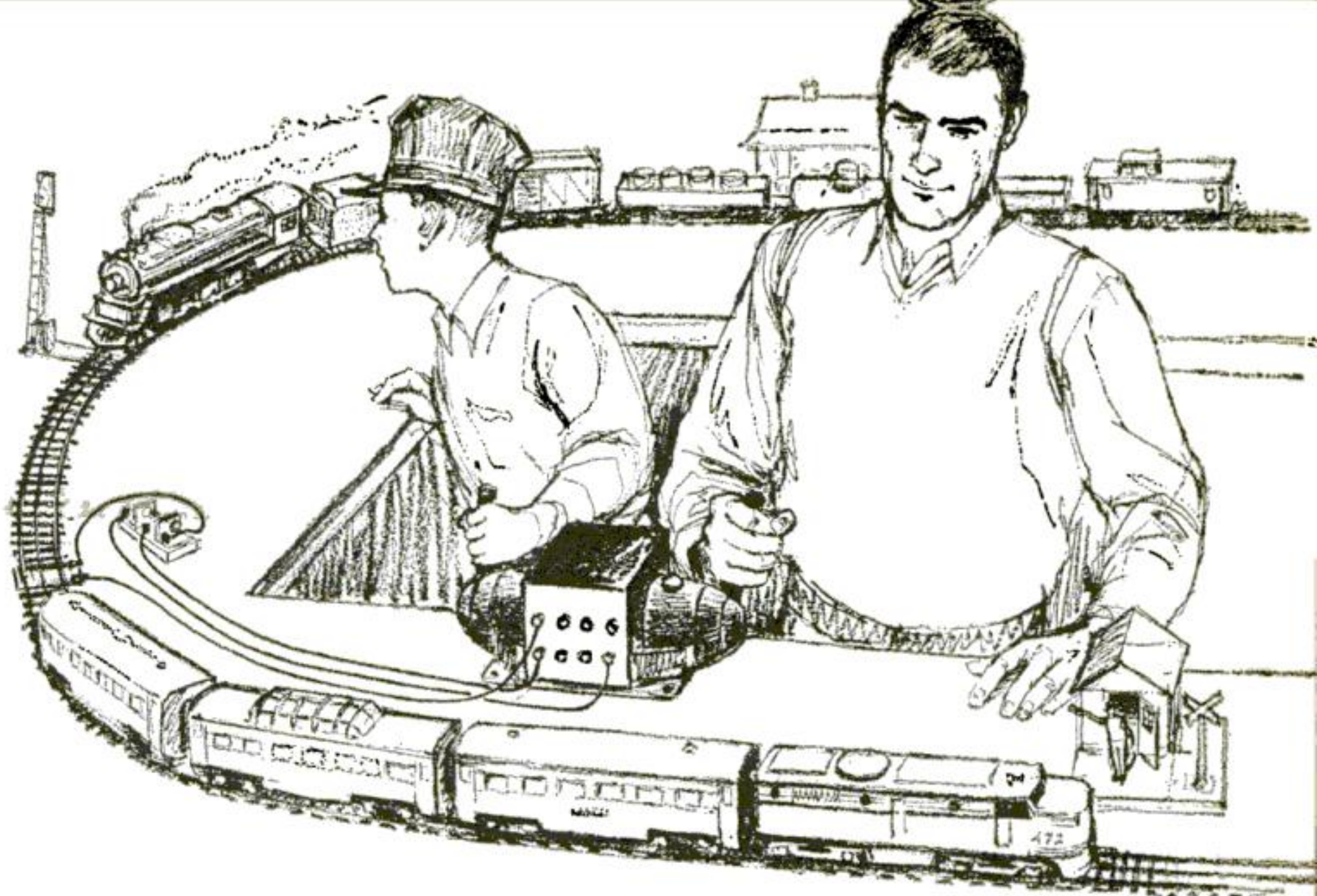
By Thomas Gluszcak

**H**ERE is a simple electronic system you can make that will give you completely independent control of two separate trains on the same track. It will work with either Lionel or American Flyer trains—on tracks with either two or three rails.

If you've tried simultaneous operation on an ordinary layout, you know what the difficulties are: To prevent one train from overtaking the other, a complicated system of blocks must be used. The block system works, but it is extremely difficult to fit into







larger layouts. And it allows little control of the train's speed.

Easy availability (and a drop in price) of silicon rectifiers makes the new system feasible. These are the thimble-size, semiconductor devices that have been simplifying power supplies in everything from TV sets to space capsules recently.

You'll need four. Any silicon rectifier will work as long as it is rated at 10 amps, 50 p.i.v. (peak inverse volts), or more. You can order them from any of the large radio-parts mail-order firms if you can't find them locally. Two will be used at the transformer and one in each locomotive.

**Hooking it up.** Use two short pieces of aluminum angle to mount two of the rectifiers on a wooden terminal block. The photo shows the arrangement of the angles and three binding posts used for convenient hookup between the transformer and track. Notice in the diagram that one rectifier is connected with polarity reversed with respect to the other.

These rectifiers, of course, must be connected to independently variable sources of low-voltage AC. If your transformer has two variable outputs, there is no problem. If you use separate transformers, you may find that you have to interchange the leads

from one if the system doesn't work properly when you hook it up.

To install the rectifiers in the locomotives, you simply break the lead from the pickup roller to the motor and solder in a rectifier in series. The only precaution is to be sure you connect the plus (+) terminal of the rectifier to the pickup roller in one locomotive and to the motor in the other. In other words, you want the rectifiers hooked up oppositely.

**How it works.** Rectifier CR-1 conducts only during the positive half of the current alternation, making the third rail positive. The rectifier, CR-2, in one of the locomotives, allows current to flow to the motor only when the third rail is positive. So the speed of this locomotive will be determined by the amount of AC voltage fed to CR-1. A similar explanation applies to CR-3 and CR-4 for the negative half of the AC cycle. Since one motor will receive current only when the third rail is positive and the other only when it is negative, the trains can be operated independently.

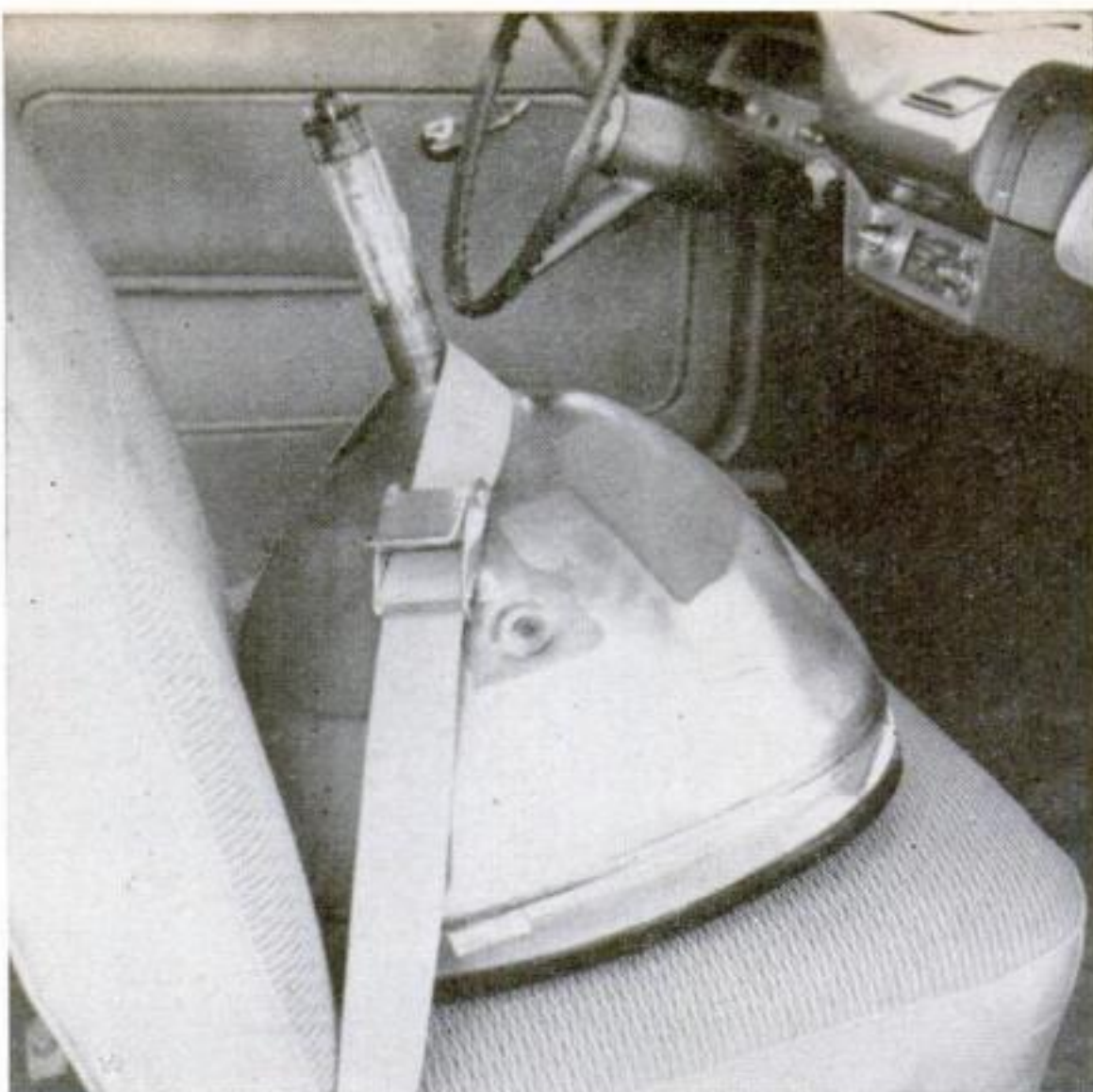
Every function of the locomotive is retained except the use of the horn or whistle. It will sound continuously unless one of the leads to it is disconnected.



## How to haul a TV tube downtown for repairs

I service my own TV set, and hauling a burned-out picture tube downtown to exchange it posed a problem. It had to be anchored down so that a sudden stop wouldn't damage it. As one serviceman said, "You've got to handle a tube like a hand grenade with the pin out."

My wife had a suggestion. "Why not anchor it down with the seat belt?" she said. It worked like a charm.—*S. Stresnic, Ft. Lauderdale, Fla.*



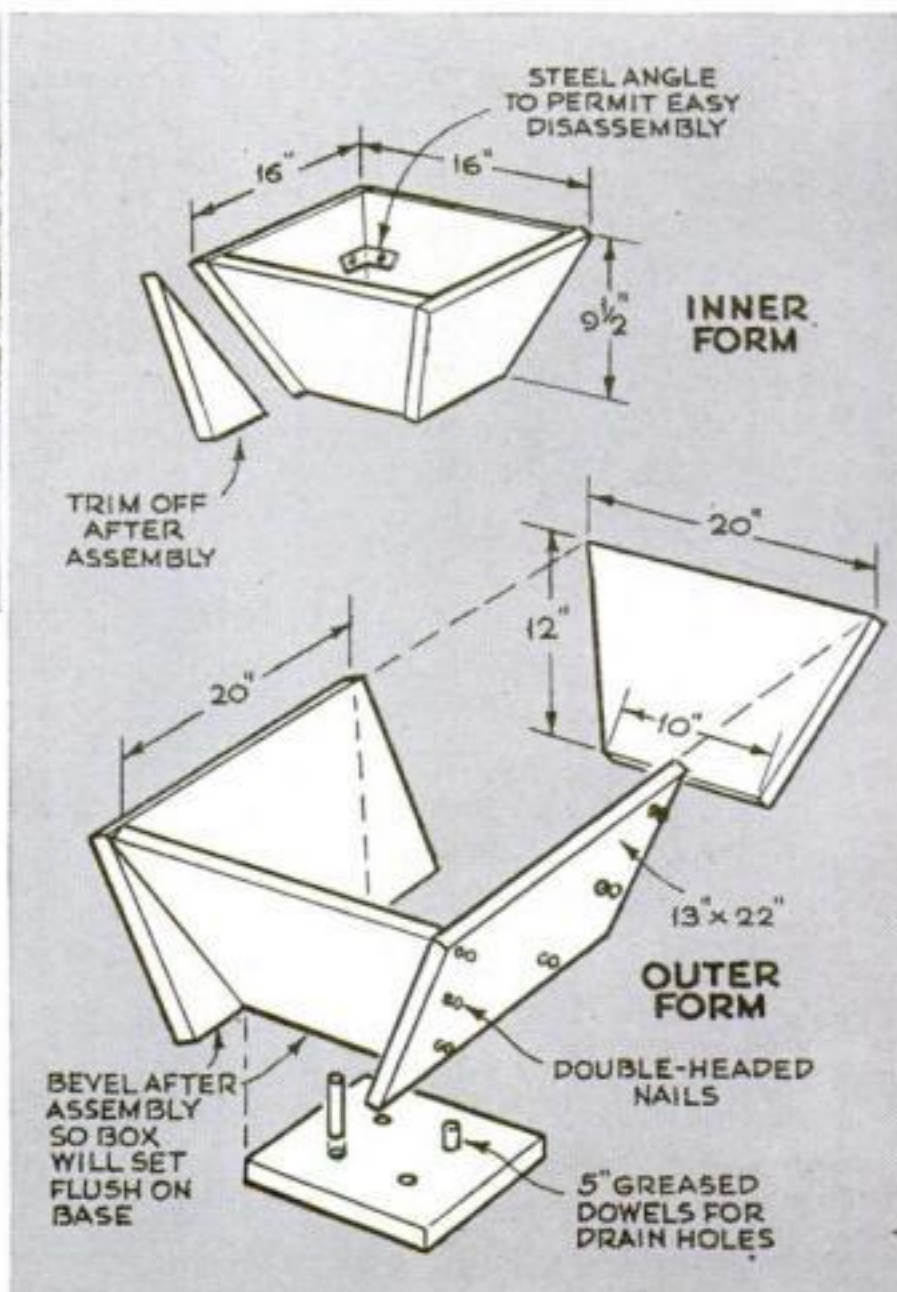
▶▶▶ Getting out my pressure spray tank, I found it corroded quite badly, with several tiny holes. Since the season was nearly over, I cleaned and dried it well, coated it with varnish inside and out, and set it out to dry

in the sun. It worked well. The way it looks now it'll remain usable for several years to come. Think I'll do the same thing when I buy a new one.—*Dr. C. O. Patterson, Grass Valley, Calif.*

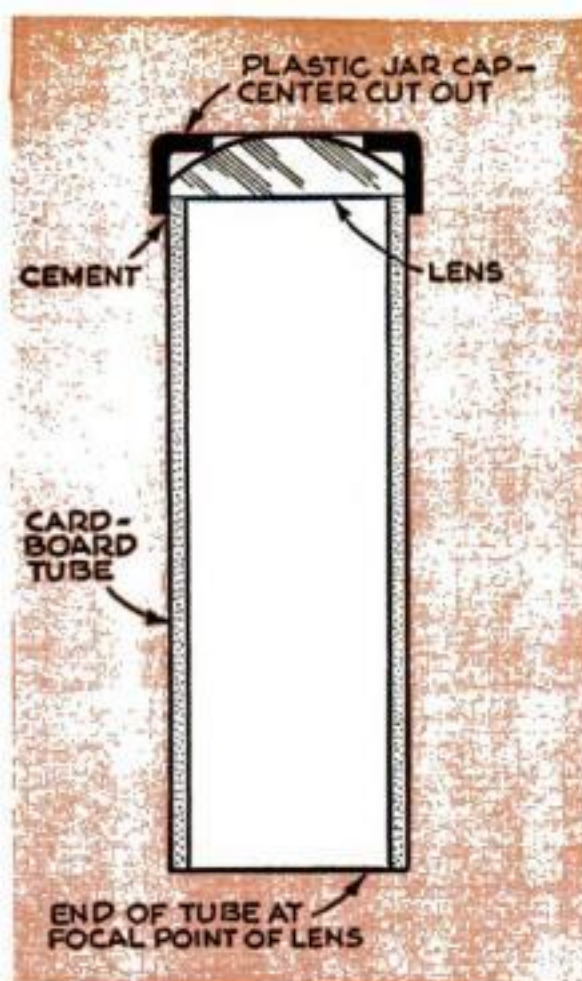


## Casting a concrete planter box

Forms for casting a hopper-shaped planter are easy to make. Coat the plywood surfaces with crankcase oil. Mix: 1 part cement, 1½ parts sand, 2 parts ¾" pebbles. Pour a 2" layer on the bottom of the outer form; set the inner form on top of this, and pour concrete between. For a rough texture, use a fairly dry mix and go easy on the tamping. For strength, lay in a reinforcing rod bent into a square when the form is half full. Let the concrete set two days, then remove the inner form.







PS PHOTOGRAPHY

## 3 Tips for Better Photos

### Magnifier sharpens focus

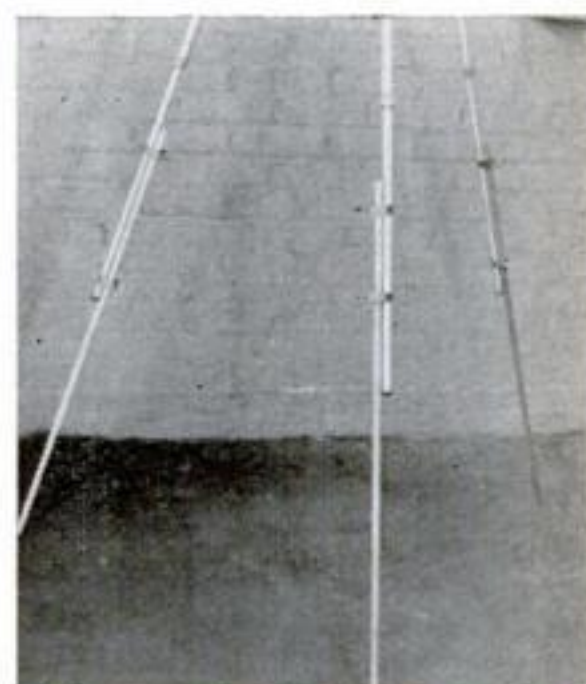
A magnifying lens mounted in a cardboard tube makes focusing with the ground glass of my camera a lot easier: The tube shuts out extraneous light behind the camera and keeps the magnifier at the required distance from the glass while I adjust the

focus. Any magnifying lens that focuses at 5" or 6" is usable, but a binocular objective will give the flattest field. I fastened the lens in place with a plastic jar cap from which I had removed the center. Or, you can tape it in place. Trim the tube to the exact length required to focus.—Herbert R. Pfister, Glen Head, N. Y.



### Adjustable camera stand for close-ups

For photographing table-top setups, a regular tripod is often too clumsy. I made my own support from walnut scraps, assembling it with screws and glue. After beheading two machine screws, I soldered wingnuts on them. One went on the camera mount; the other holds the pieces together. After removing the camera, you can screw a retaining nut over the mounting screw. It's better, however, to drill a hole through the screw for a retaining pin.—Fred C. Schnelz, Detroit.



### Leg extensions for tripod

Frequently needing an extra foot or two of tripod height, I hit on this scheme. I bought six thumb-screw hose clamps at an auto-supply store, and three 3/8" hardwood dowels. Using two clamps to a leg, I secured a dowel to each. Now I've got a support to get my camera up where I need it.—H. J. Gerber, Menomonie, Wis.



# How to Find Space for a Shop...

when there isn't any

"No basement. No spare room. No spare space in the garage either. We do have a utility room and a family room, but how can I turn either one into a workshop?"

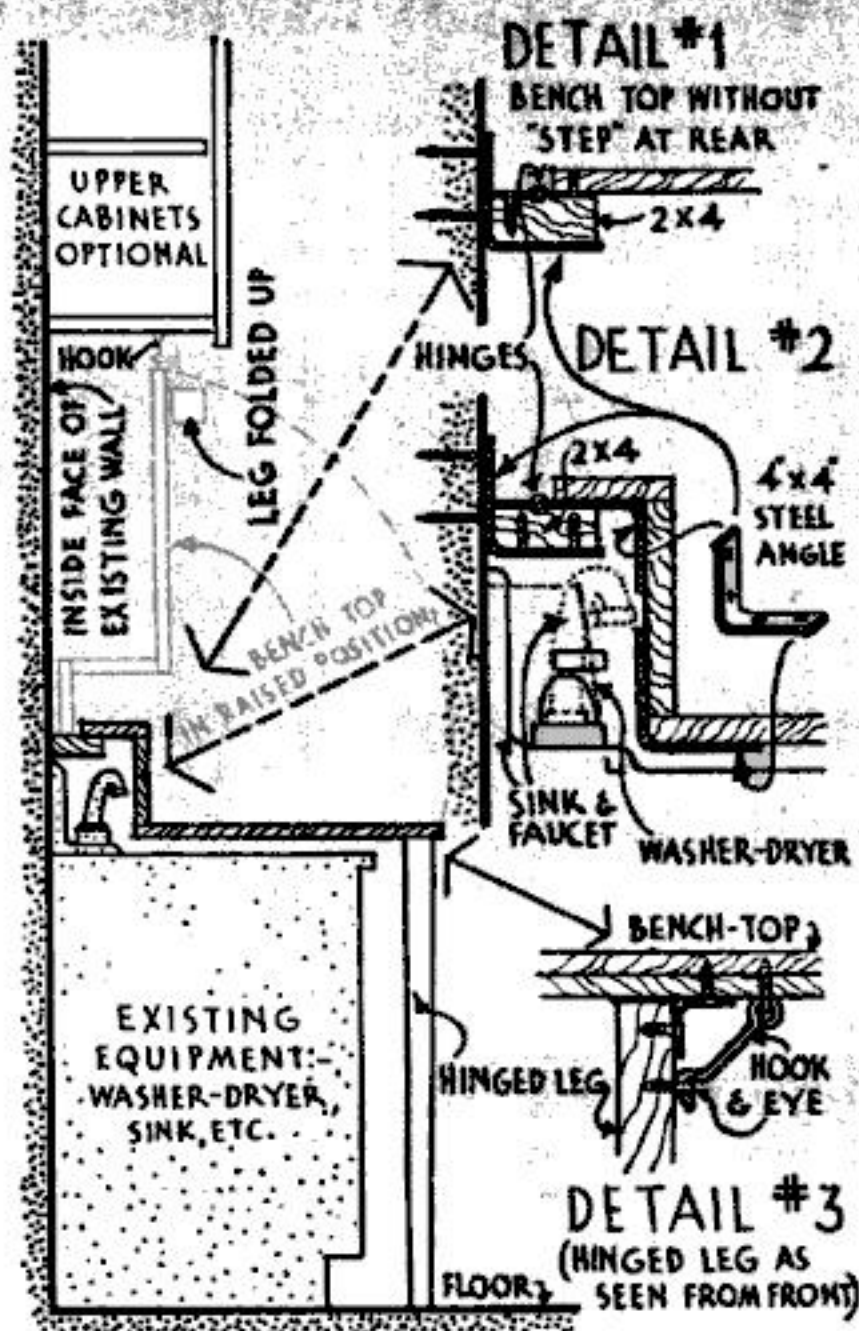
That's a common complaint. We have heard it many times in various forms. But we were sure there must be solutions. There are. Here architect Gerald K. Geerlings presents four for your consideration. —The Editors.

By Gerald K. Geerlings

THE only chance of finding home-shop space in an already crowded one-story house is to make single-use space, which earns its keep only part time, do double-duty. There are three such suggestions on this and the following two pages. On a fourth page we face up to the no-space-at-all situation.

**Solution No. 1** makes use of a laundry area where equipment is not usually doing chores at times—evenings or weekends—when a man has a yen to work with his hands. Combining the two types of activity will curtail some of the storage space normally used for laundry supplies, but selective elimination of oddments, plus ingenuity in finding new shelf space elsewhere, can solve that objection. Obviously it is essential that the bench top be designed so it won't interfere with existing (or future) laundry equipment, such as sink faucets or control panels for a washer-dryer.

Even though the plans show a sturdy mounting arrangement for the bench, there is always the possibility of an unanticipated healthy wallop that might loosen screws



**Solution No. 1:** A utility room usually has a washer-dryer, perhaps a sink and wall cabinets. It could also include a workbench, hinged to swing up and out of the way when not in use. The drawings above and at right show how a

that hold the hinges. Where possible, it's best to use additional cleats (to support the ends of the bench top) or a leg positioned at the rear.

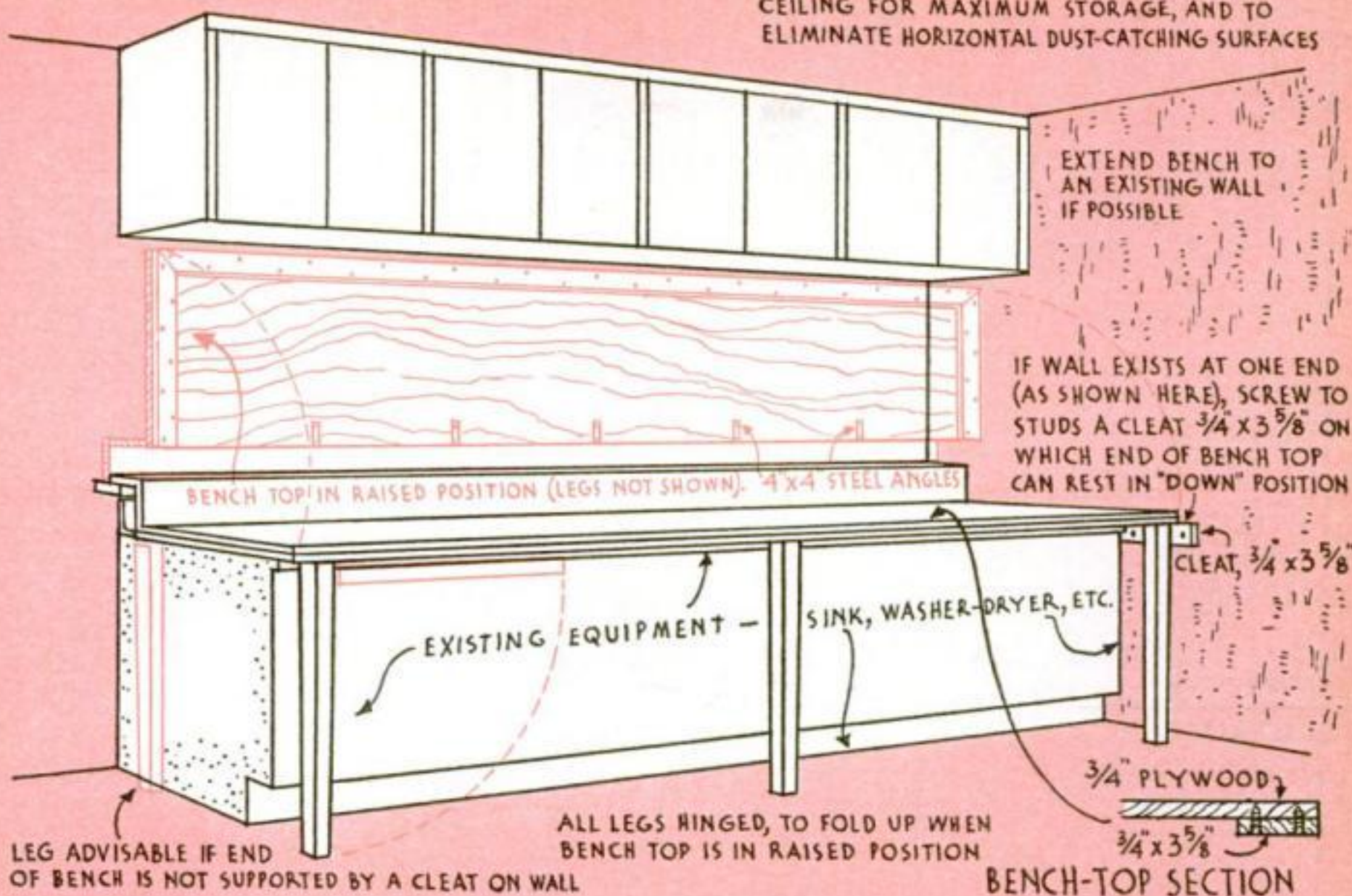
Detail No. 3 at the top of this page is typical for all hinged legs in this and other suggested solutions: There should always be a secure means for keeping the leg in a vertical position (when the bench top is being used), as well as some hook-and-eye device to keep it folded back against the bench top when the top is hinged back.

The details on this page for the bench top can also be applied to the other solutions. Plywood  $\frac{3}{4}$ " thick, with  $\frac{1}{4}$ "-by-3" wood strips screwed around the edges, will produce a sound, nonwarping bench top. One caution: When installing hinges, never screw into the end grain of plywood.

**Solution No. 2,** a workbench that can be concealed, is a good way to double the use



UPPER CABINETS OPTIONAL. EXTEND TO CEILING FOR MAXIMUM STORAGE, AND TO ELIMINATE HORIZONTAL DUST-CATCHING SURFACES



BENCH-TOP SECTION

bench top with hinged legs can be mounted over existing equipment. Detail No. 1 applies when a bench can be hinged at the wall like a horizontal door, while Detail No. 2 shows a step construction at the wall to clear faucets

and washer controls. Door hinges can be used to hinge the bench top to a two-by-four firmly anchored to wall studs (use 4"-by-4" steel angles at each stud). Legs should be about 3"-by-3", hinged to fold up when not in use.

of a family-activities room where several members of the family are eager craftsmen and have various tools and bits of equipment scattered about. (It is no solution for the family that demands an ever-prime, dust-free retreat). Where the bench end is open, as shown at the left in the drawing, you may want to enclose it with plywood to prevent tools and small parts from falling to the floor.

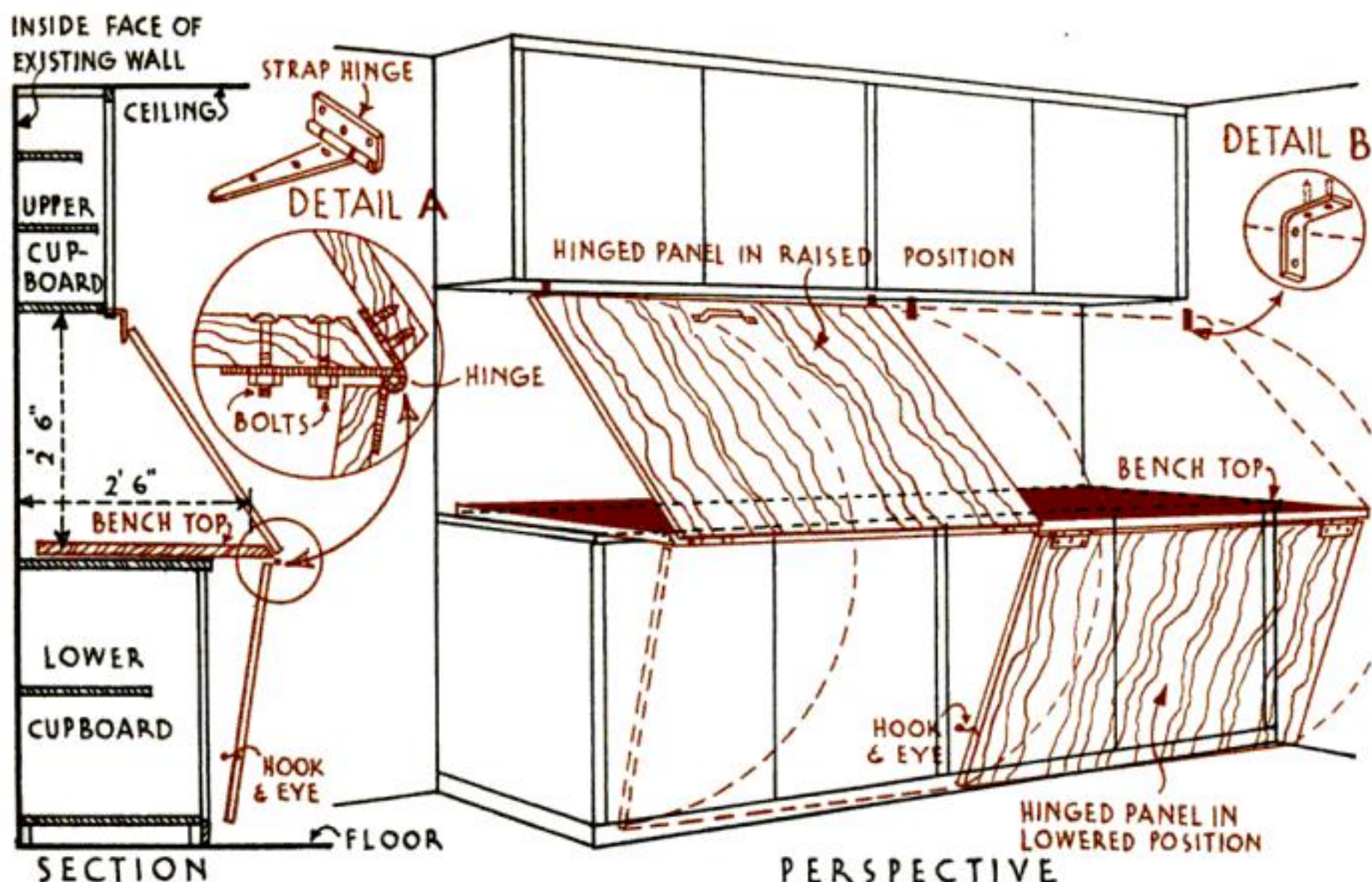
**Solution No. 3** is an inexpensive folding bench that takes up practically no space. It can be raised to its usable position in a garage when the car is moved out, or in a family room when the space is not being otherwise used. A hinged workbench has many drawbacks; nevertheless it may be a start toward a permanent, full-fledged workshop later. The problem of having to clear a folding bench each time it is collapsed can be eased somewhat by adding shallow

storage cabinets above the work area so that tools can be quickly put away.

There are several problems you will want to bear in mind as you track down space for a workbench. You should be able to store materials nearby. Space requirements will vary according to the materials you use in your work and the quantities you stock. Be sure that the longest lengths or largest sheets can be brought to the storage and work location. (If in doubt, use something as a mock-up to negotiate the necessary turns and twists.)

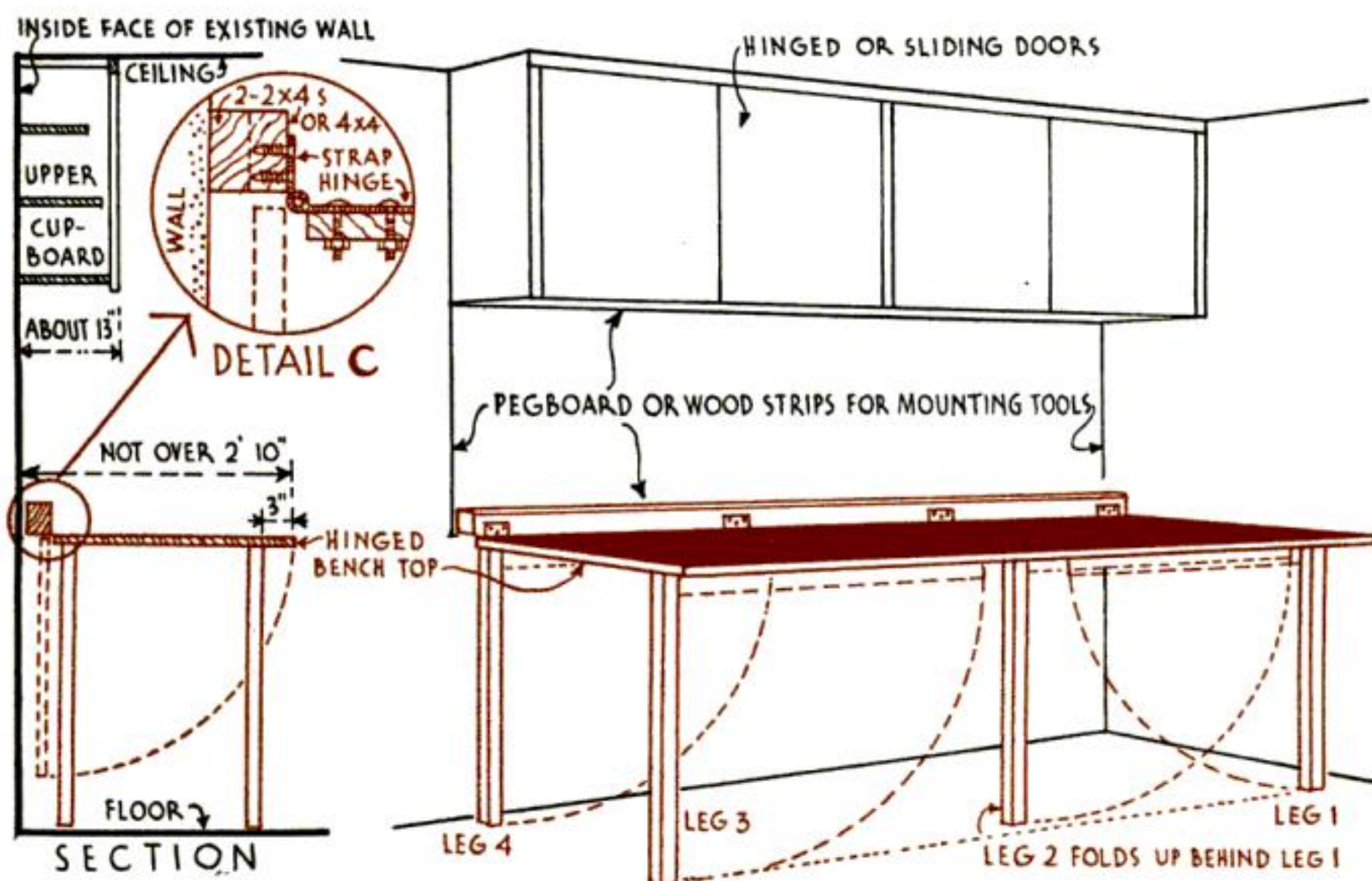
Dust and debris should be frankly discussed with other members of the family to avoid objections later. Noise and vibration should also be considered. Perforated hardboard on walls and acoustic tile on ceilings will help reduce noise. But nothing is as important as the sympathetic understanding of other members of the family.





**Solution No. 2:** A hideaway workbench can be built in rooms where an open bench would normally be out of place. The drawing shows standard upper cupboards, with a bench top over lower cupboards. Tools and work-in-

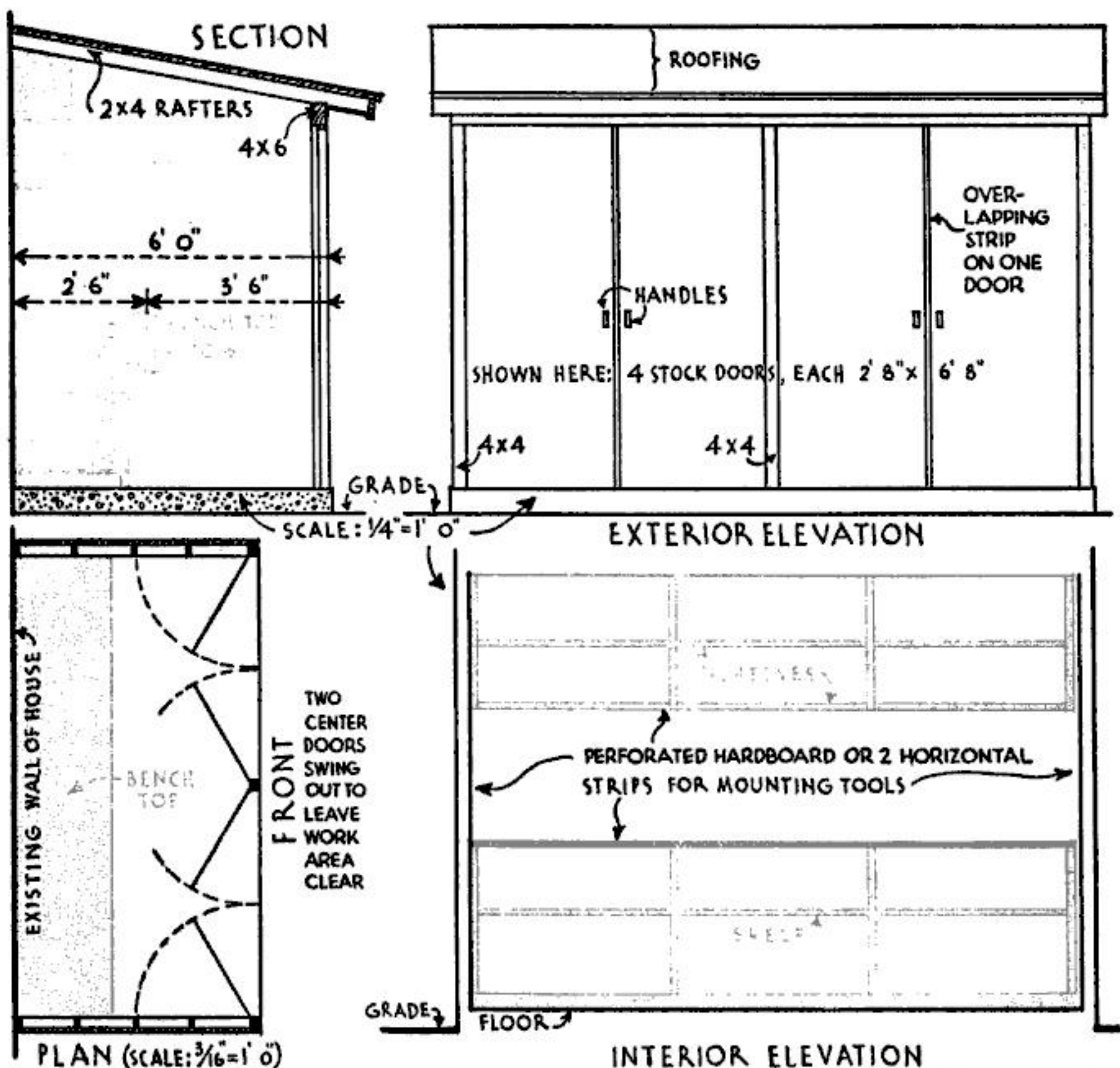
progress are covered up when not in use by hinged panels, as shown. In the lowered position, these panels should incline inward to provide toe space. In the raised position, they can be locked to make the tools childproof.



**Solution No. 3:** Where there's no space for a permanent bench, one can be hinged to fold flat against the wall when not in use. Its hinged legs also fold flat. Tools and work-in-progress can be kept in shallow overhead cup-

boards that don't steal floor space. Detail C shows how strap hinges can be fastened to a rail on the wall. Legs should be located at corners and at intermediate points (as leg 2 above), and secured both in use and folded.





**Solution No. 4:** A lean-to against a house or garage may solve your problem if there is absolutely no space indoors. The floor should preferably be cement (pour it as you would a sidewalk). Erect four-by-fours at the corners and between doors as shown. End walls can be two-by-four studs, covered with exterior-grade plywood. Roof rafters can be two-by-fours if the depth of the lean-to is not over 8'. The front consists of stock doors that open to give

### INTERIOR ELEVATION

maximum accessibility to the bench. One advantage of a lean-to workshop: Tools, work-in-progress, and dust and debris can be isolated from the house. If most shop activity will take place during warm weather, heat is no problem. However, there now are many electric units and a choice of oil or gas space heaters that can make the shop comfortable in winter, with insulation in walls and between rafters. Storm doors will help in a severe climate.

**Safety measures for tools** may have to be more stringent in a double-duty room or space than in an isolated location. Tools and finished work within view and reach of children are bound to be a temptation. You may find it wise to place all "don't-touchables" under lock and key. Power tools require special precautions of their own. No amount of thought or cost is wasted in developing a childproof system whereby no manner of manipulating main switches, secondary switches, or inventive wiring and cross wiring, can induce a single tool to

turn. It may require locks—perhaps even, instead of the key type, top-grade combination locks. ■ ■

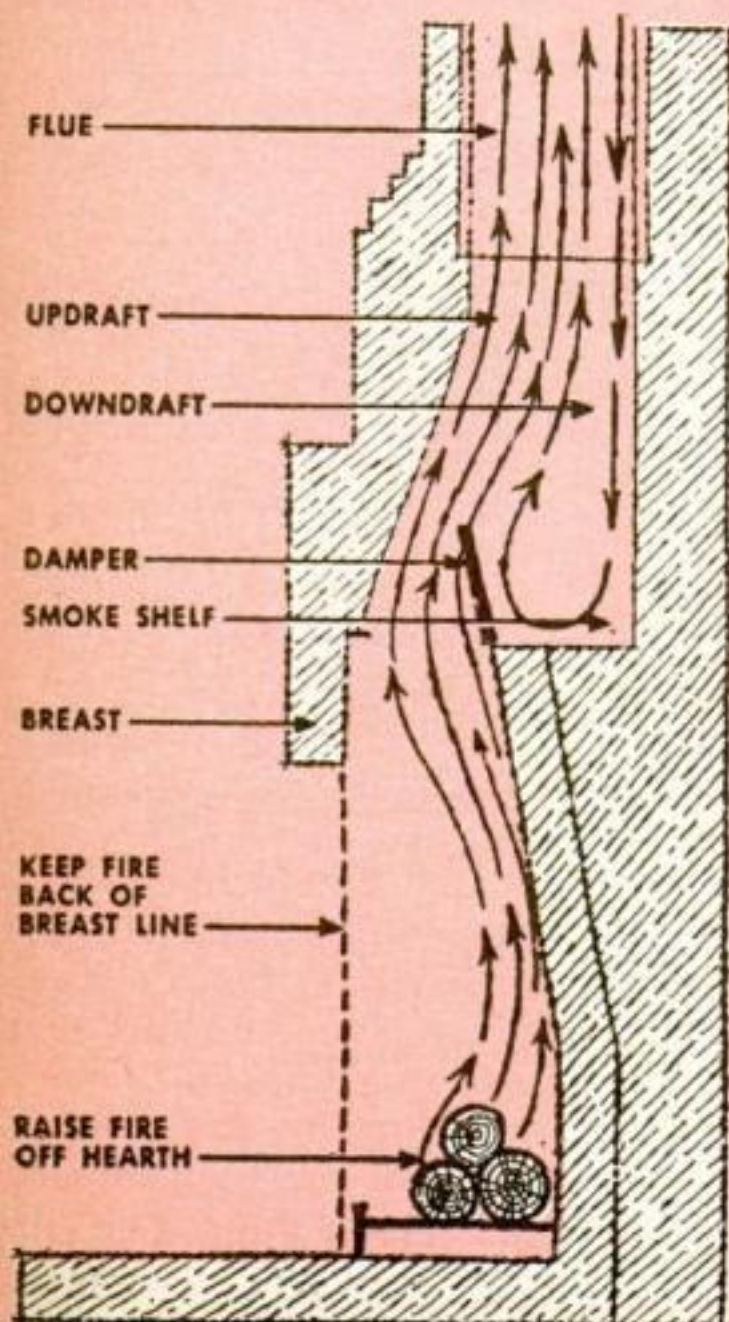
►►► No place to store back-yard barbecue supplies? Install a closet pole somewhere in the basement and hang up one of the plastic garment bags used to store shirts or sweaters. The plastic shelves will hold paper plates, napkins, barbecue tools, and other lightweight items. When the bag is zippered up tight, no dust can enter.





# How to Stay Friends with a Fireplace

By Jackson Hand



A well-laid fire has at least three logs, placed split-side down over kindling before you light it. The round chunk in the photo above is a "back log." In a deep fireplace, it helps keep fire forward, providing better heat. At left, section through a typical fireplace.



## Warmth? Cheer? Know-how will get you either—or both—and make it a friendly hearth forever

**A**NY pile of shavings, sticks, logs, and debris will burn if you have enough matches and patience. It may smoke and smell. But it will burn, in its own, unlovely way. Perhaps that is why you hear people say . . .

"Yeah, we have a fireplace, but we never use it."

"Doesn't burn right. Bum masonry job."

"Fireplaces leave us cold."

Most likely such people never learned the simple techniques that turn a fireplace into the place of warmth and cheer a family hearth is supposed to be.

**Lay it all at once.** The first mistake many frustrated firebuilders make is to pile up papers and kindling and set them afire. Then, when the small stuff is blazing well, they put on the larger wood. If you want a good, quick fire, one that keeps burning, lay it all at once.

Crumpled or twisted newspaper comes first, topped by small-split kindling or twigs piled crisscross or teepee fashion—whichever you like. Then the logs. *Now* light it up. With this system, the logs are warmed right from the beginning and ignite readily.

**It takes more than one log.** The second common mistake is trying to make the fire with only one or two logs. This may work if you have enough kindling and keep adding to it. Properly, you should start with at least three logs. Lay one at the back of the andirons but not quite touching the back of the fireplace. Put the next one a bit forward. Lay the third one atop these two, forming a sort of pyramid. There's a reason.

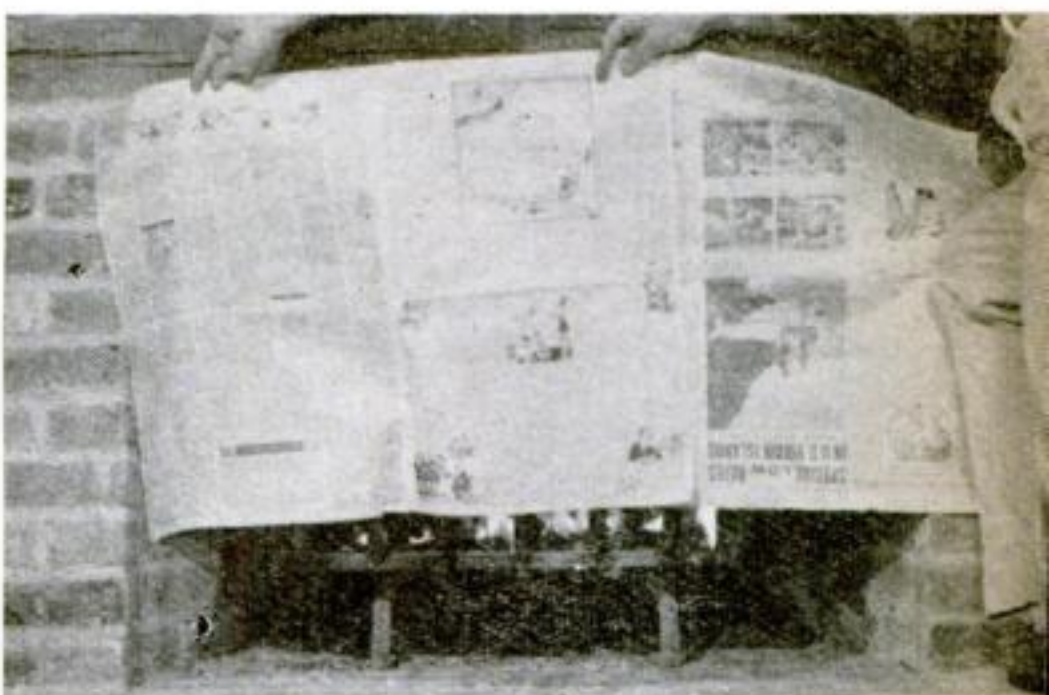
As each log heats and finally ignites, it radiates and reflects heat to the others. Singly or doubly there may not be enough heat to keep things going.

It's a fallacy to expect the bark of a log to ignite more readily than a split surface. Bark is an efficient insulating material, provided by nature to protect a tree from heat. For the quickest fire, place the split sides down. For a back log, pick one that is mostly bark or perhaps unsplit. (This is true even of birch, whose papery outer bark is resinous and makes excellent kindling, but whose inner bark resists burning.)

Unless you know your fireplace—and



Before you light a fire, especially at the beginning of the season, it helps to start a draft roaring up the chimney if you hold a flaming newspaper high in the fireplace throat.



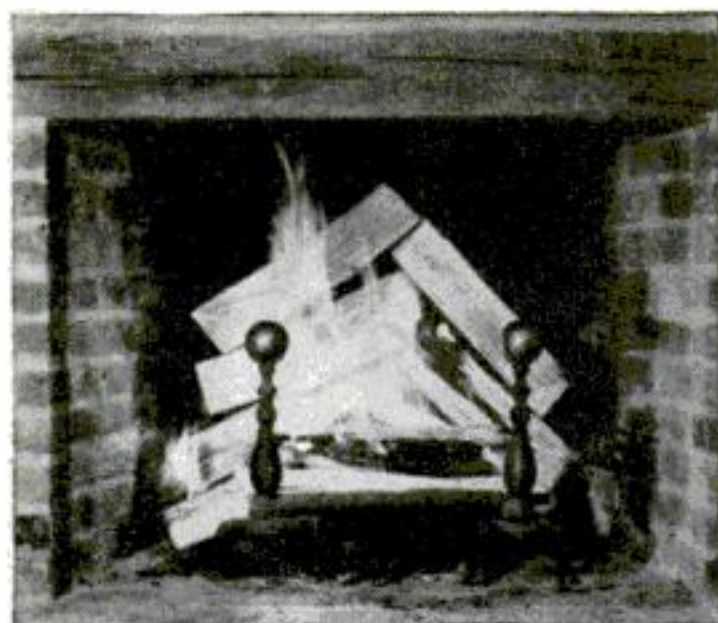
You can coax along a new fire by "drawing it up" as above. The newspaper increases the draft at the bottom, fanning the coals and bringing the flames to a roar in a hurry.



In putting a fire to bed, stand any burning logs in the back corners and they'll soon die out, leaving good starting pieces for next fire. Be sure to put the screen back in place.



# What kind of wood? On the basis of heating value, the Forest Products Lab. at Madison, Wis., rates common woods like this:



A festive look and much heat are the rewards for an up-the-back fire, either herringbone as above, or straight-laid sticks of diminishing size. Kindling ignites the face of the logs, radiating heat from a large area.

BEST	GOOD	POOR
hickory, oak, beech, birch, hard maple, ash, elm, locust, apple, cherry	shortleaf pine, Douglas fir, red gum, soft maple, sycamore, chestnut	cedar, redwood, poplar, cypress, basswood, spruce, white pine

Pines and firs burn very hot for a short time because of the presence of resin, which gives about twice as much heat per pound as does wood. If you have a choice at all, bear the points below in mind in selecting firewood:

- Soft woods ignite easily.
- Light woods burn quickly.
- Heavy and hard woods burn longer.
- Dry, light, soft woods give less smoke.
- Spruce and hemlock crackle and spark.
- Apple burns with colored flames.
- Elm burns with little or no flame.
- Birch gives a bright, intense flame.

your fuel—well, it isn't smart, for safety reasons, to use more than three logs to start. As the fire burns down, add one log at a time. It's a good idea to turn the unburned ends in, if logs burn in two, before adding more fuel.

In the fall, when starting your fireplace for the first time after the summer layoff, use a little more kindling and patience until the masonry is warmed up and the family hearth is in the mood for a cheery winter of service.

**Preparation helps.** So much is known now about what makes a fireplace work that few are actually poorly built. Most masons understand the technicalities, and in addition a growing number of family hearths these days are being constructed around foolproof steel or iron cores. There are, however, some things you can do to make any fireplace work better.

Use andirons, or a pair of small, round green logs, so that the draft can draw fresh air under and up through the fire.

When you clean the fireplace, leave an inch or so of ashes under the andirons. It is easier to start a fire when ashes insulate the kindling from the cold hearth.

Before you light the fire, touch a match to a loosely crumpled double sheet of paper and hold it high up in the throat of the fireplace. The heat warms the chimney and starts the draft immediately.

Normally, start the fire with the damper fully open and close it gradually as the fire

grows. In some cases you may find that the fireplace works best with the damper partially closed, even at the beginning.

Don't use your fireplace to burn refuse, trash, and old papers. Repeated "incinerator" use of a fireplace will fill the throat, smoke chamber, and flue with soot.

If you have a new house or a new fireplace, start out with small fires, until you learn how to run things.

**Does your fireplace smoke?** The most common reason is insufficient draft. Fireplaces may be a little touchy in modern, low-roof houses. (A chimney less than about 16 feet produces less draft than old-time fireplace men like to see.) However, a good, well-behaved fireplace may take to smoking because of . . .

**Cold flue.** Warm it up with a flaming newspaper, high in the throat.

**Cold hearth.** Ashes prevent this.

**Vacuum.** Many modern houses are so tightly built that a fireplace cannot get enough air. Crack a window slightly, or perhaps open a basement door.

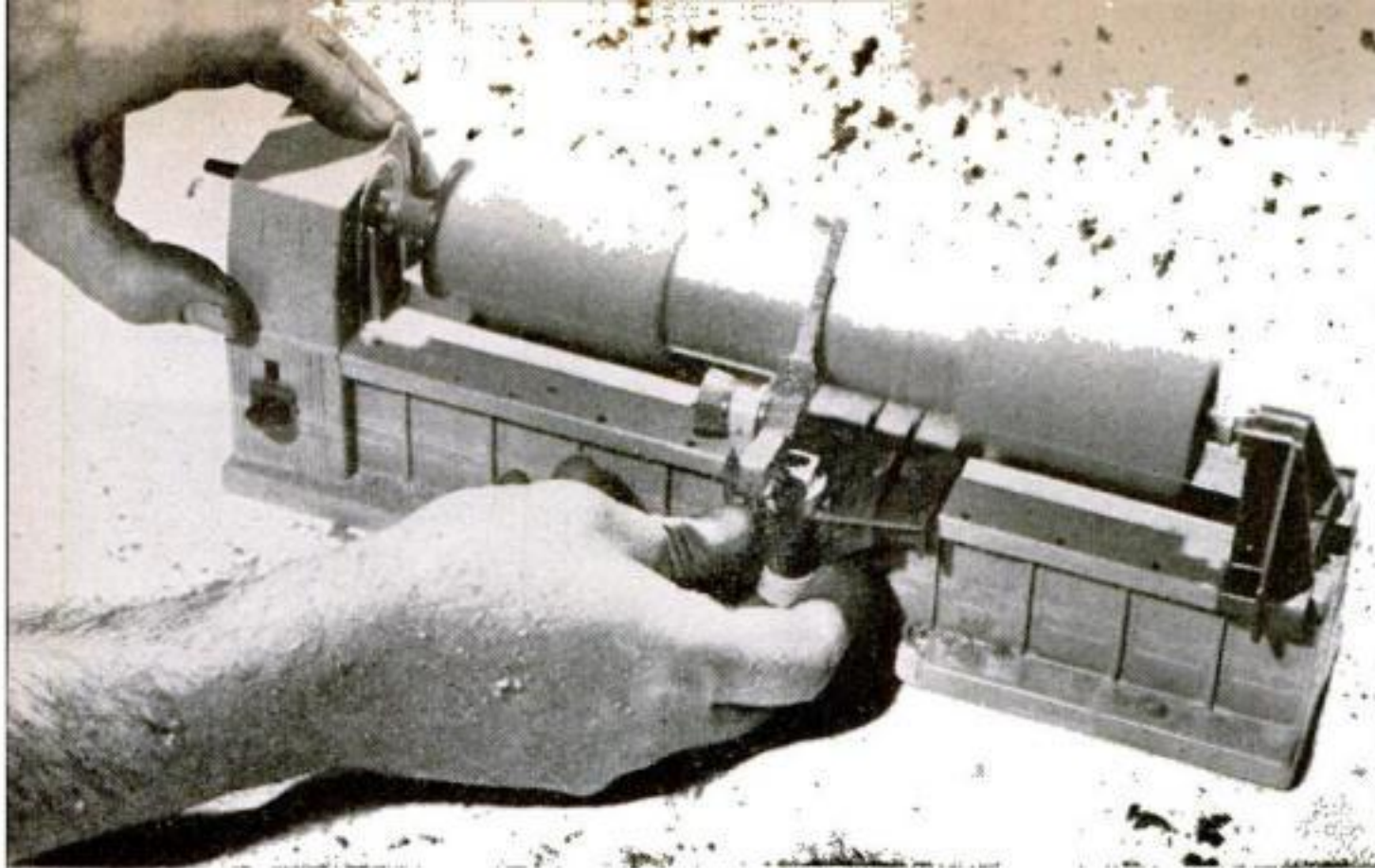
**Competition.** A kitchen ventilating fan may suck air down the fireplace chimney. Turn the fan off.

**Crossdraft.** Air moving across the face of the fireplace may draw air out into the room. See if there are open doors flanking the fireplace—and close one of them.

**Clogged flue.** Look up it or down it, and if it isn't clear, call in a chimney cleaner

[Continued on page 189]





**what's new**

.....**TOYS**

## Workshop for Small Fry

Just about any job that big power tools can do can be duplicated in soft materials by this tool for junior craftsmen.

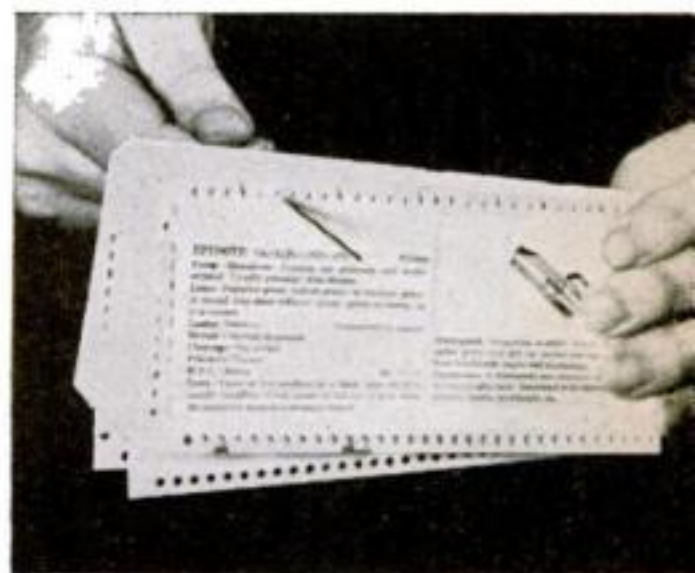
Powered by three flashlight batteries, the miniature multipurpose tool can be set up as a lathe, circular saw, jigsaw, disk sander, or drill. It's "lumber" is foam plastic and balsa wood, supplied with the tool. There's an adjustable tailstock, a machine-type

cutter that slides along the ways, even an outboard spindle for sanding large pieces and faceplate turning.

The accessories are cleverly designed to fit interchangeably on either the headstock or tailstock. Paints for finishing the work and a book of projects are included. The price is \$9.95 from Kenner Products Co., 912 Sycamore St., Cincinnati.

## Built-in record player talks for this doll

Push a button, and you start this doll talking. Lay her down to sleep, and she closes her eyes and stops. Then sit her back up, and she starts up again—until the 50 words on a record on a battery-operated player inside her run out. Appropriately named Chatterbox, she is made by Mme. Alexander Doll Co., 615 W. 131st St., NYC. Cost: \$18 to \$20 depending on clothing.



## Mineral identifier

You can quickly determine the minerals in most rocks. Newest of a set of computer cards [see Tree-Sort, Nov. '61] contains facts to identify nearly 200 minerals. Insert a needle for a known characteristic in the stack, shake—and notches let the right cards drop out. Repeat to narrow down identification. Sort-Card Co., Box 901, Boulder, Colo., sells sets at \$5.





what's new

.....BOATING

# Two Pontoon Boats for Land or Water



**Buy this one:** Riding on aft end of 12' pontoons, little cat planes briskly. Pontoons are inverted (left) when you are on the road.

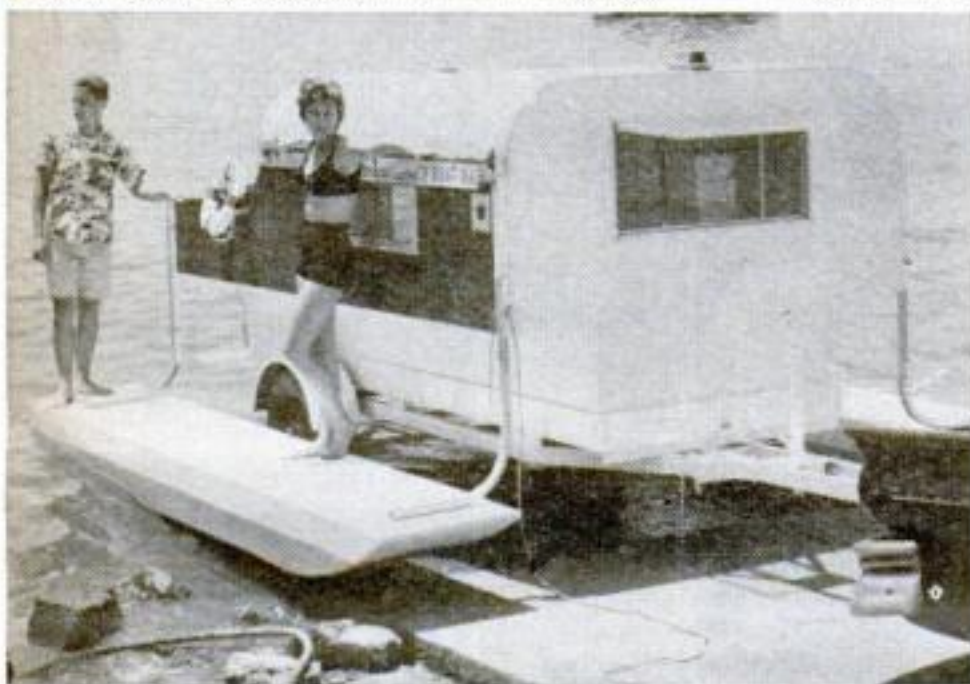


**G**OT \$1,385 or more to spend on a catamaran? The one above comes ready for the water or the road. Just drop it on a trailer or the back of a pickup truck. The one at right you build yourself from plans. Cost: \$400.

The pontoons on both are made of foam plastic. On the ready-made boat, they can be inverted on sliding pipes to fit on top of the cabin on the road, under it in the water. On the do-it-yourselfer, they form a permanent hull.

The ready-built job, called the Cee Camp, is a camper as well as a boat. Its body is designed to fit on the floor of a pickup and rest on its sides, with 6' bunks on the ledges, folding table, and 4' deck. Cee Camp is made by Copeland Engineering Enterprises, 5879 Beck Ave., North Hollywood, Calif. Price doesn't include the 40-hp. Evinrude shown, stove, icebox, or other extras.

Dow Chemical Co., Box 448, Midland, Mich., furnishes plans free for the Sea Surrey. The 8'-by-20' party or fishing deck is plywood laid on a frame of 1" lumber. Power comes from an outboard of 5 to 40 hp. In tests, the boat averaged 7 m.p.h. with a 10-hp. motor.



**Launching** needs only 6" of water. You just reverse the pontoons, back the trailer in, float the craft off.

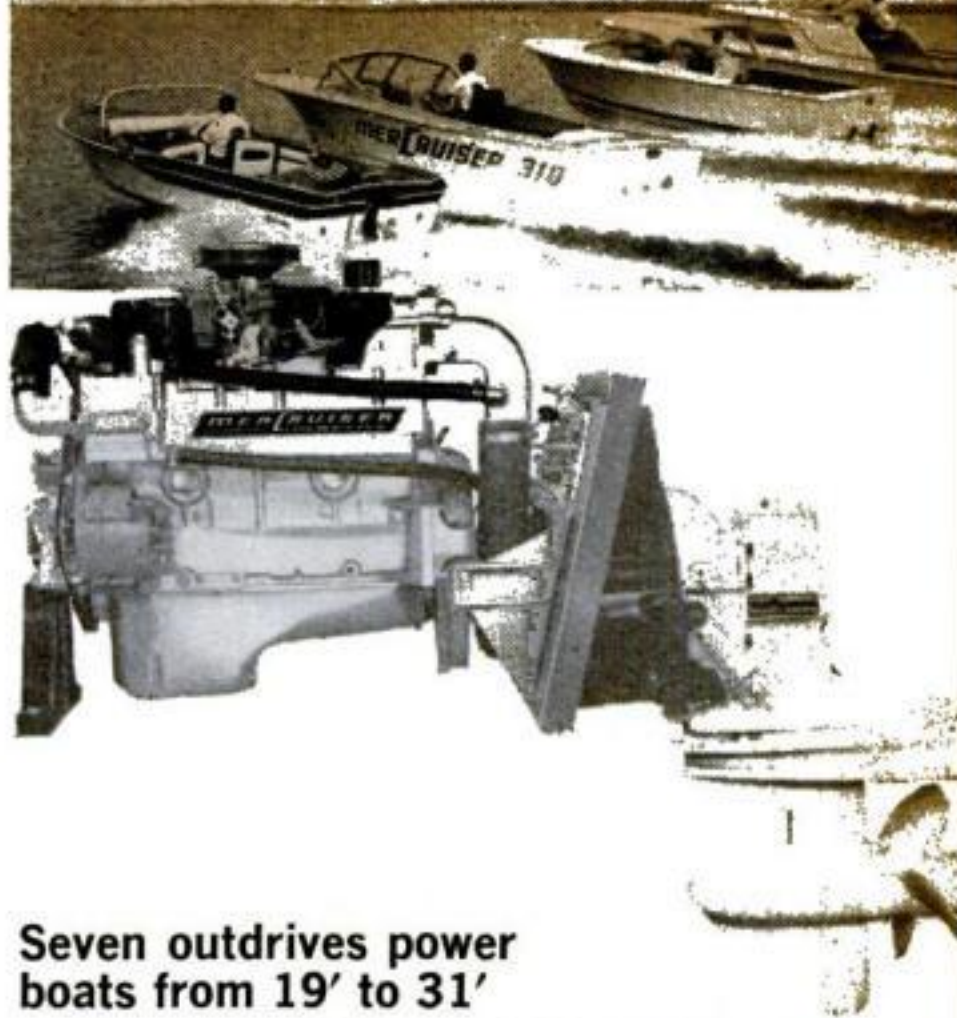
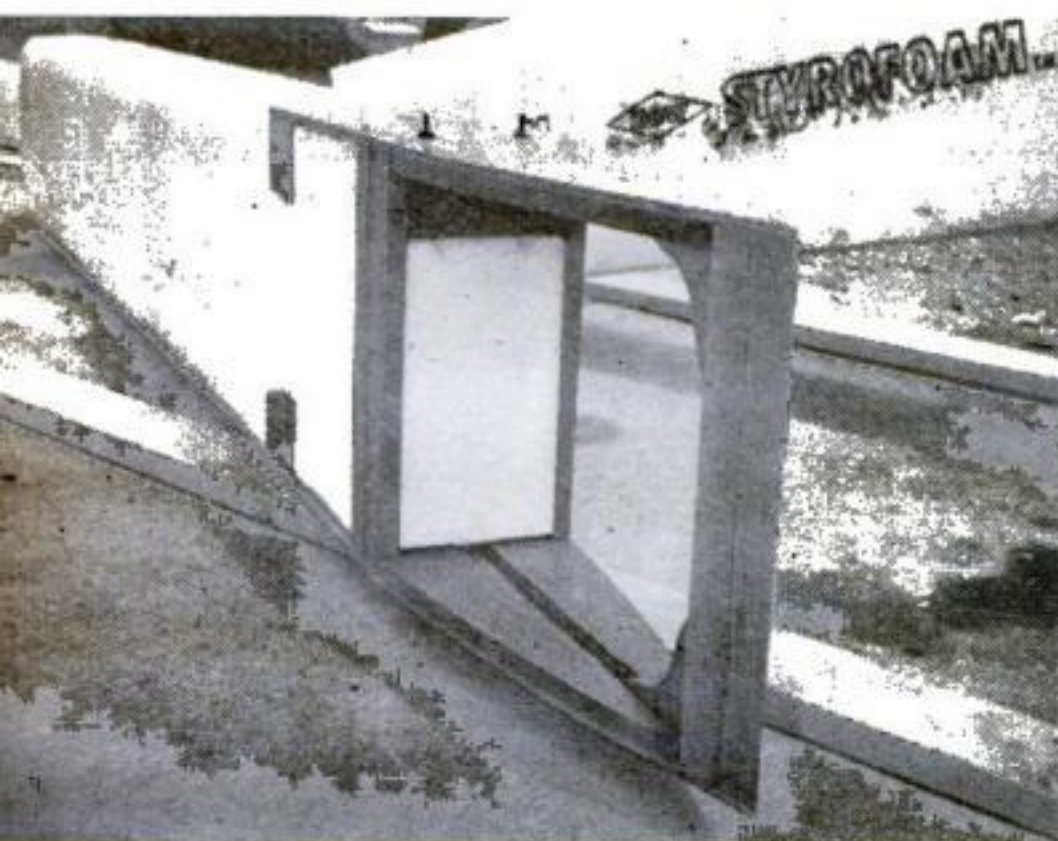




**Build this one:** Free plans are available for twin-hulled, sloop-topped craft above. Tiller centered on the deck controls outboard.



**Boat weighs about 1,100 pounds,** can be hauled over highway on trailer hitched to family car. Styrofoam billet is notched with saw (below) for prow's frame, then covered with plywood.



### Seven outdrives power boats from 19' to 31'

Mercury outdrives made by Kiekhaefer are now available for a wide variety of hulls. They include five four-in-line, six-in-line, and V-8 gas engines of 110 to 310 hp. coupled to one of two Mer-Cruiser outdrive units. Also in the line are two Mercedes-Benz diesels: a four-in-line engine developing 39 hp. and a six-in-line of 100 hp.

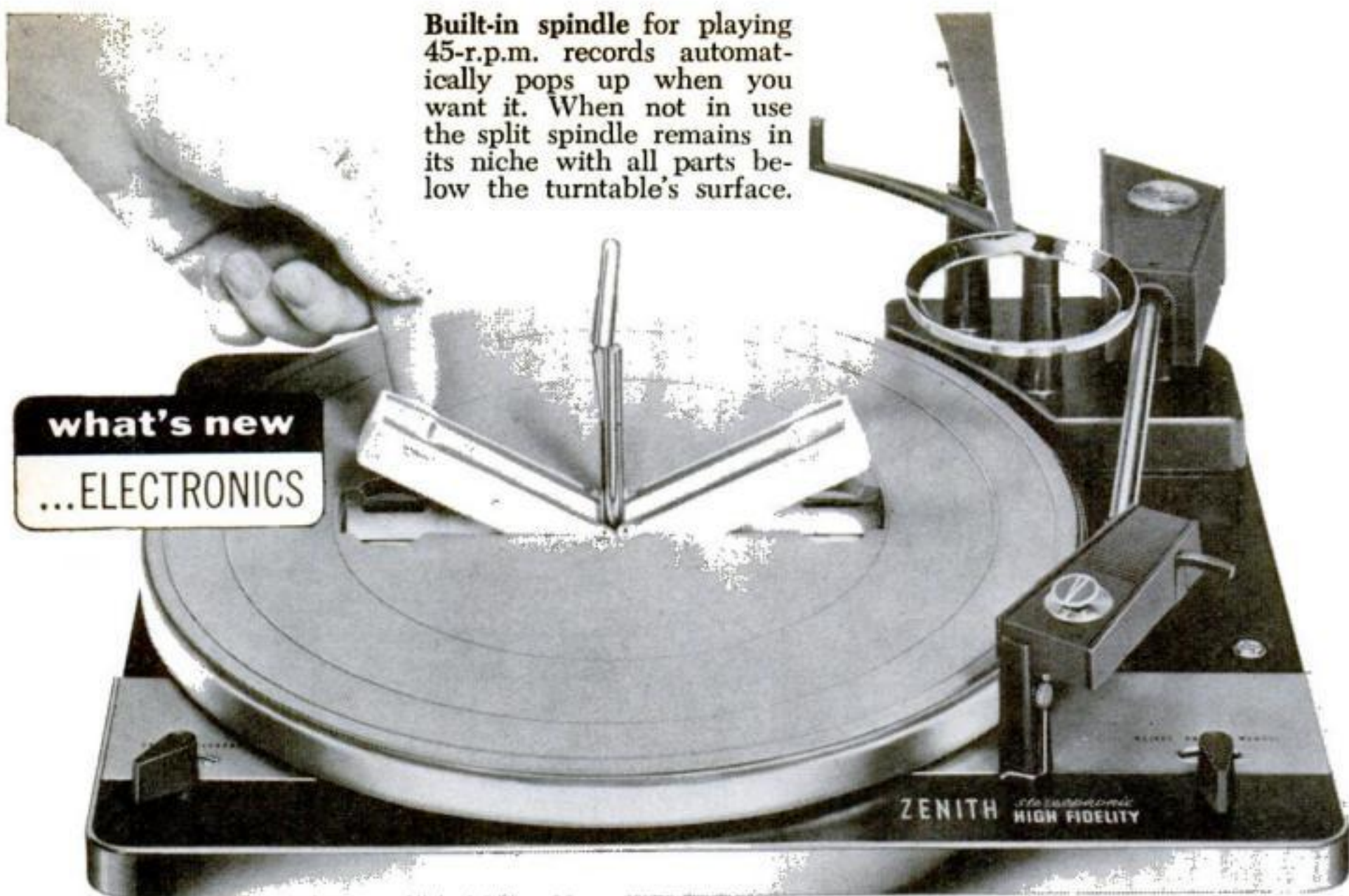


### Tilter for outboard makes it easy

A new Moto-Tilt uses simple leverage to help you tilt even a heavy engine up and out of the water with a minimum of effort. The lever stows out of sight, is said to attach to the motor shroud in one second. The device is made by Marine Railings Co., 2434 22nd St., St. Petersburg, Fla. Price: \$8.95.



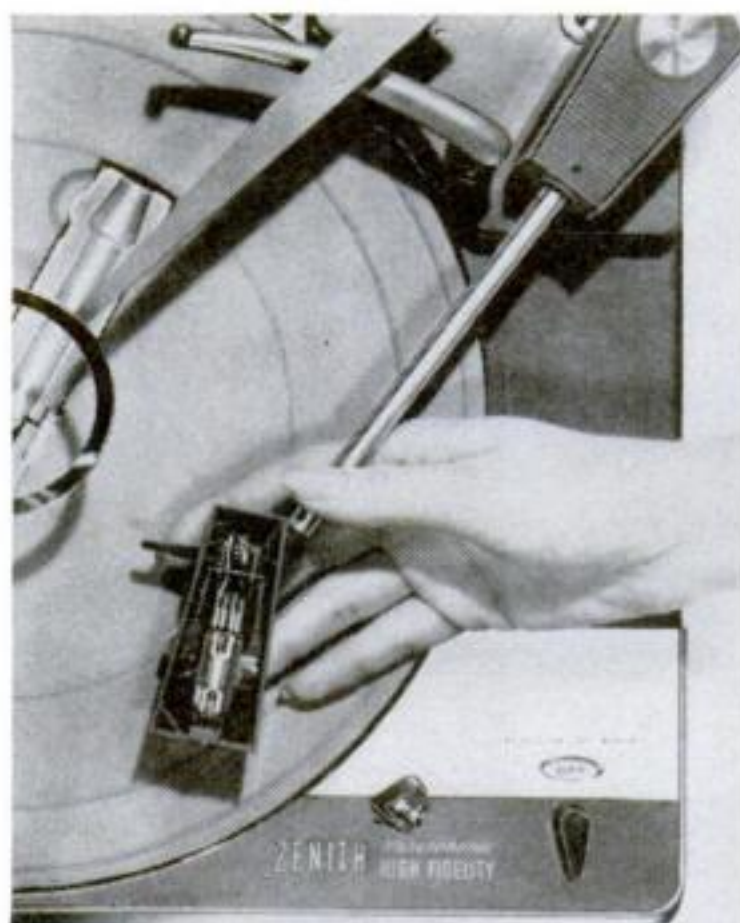
Built-in spindle for playing 45-r.p.m. records automatically pops up when you want it. When not in use the split spindle remains in its niche with all parts below the turntable's surface.



# A personal-use report on— Zenith's New Record Changer

By Hubert Luckett

**H**ERE is a new record changer in which the fetters of traditional automatic-changer design have been cast aside. The engineering approach should enchant even the diamond-tipped, automation-be-damned hi-fi buff. I have been using one for several weeks and my long prejudice against



Convenience features include tone-arm head (left) that can be turned up for inspection or stylus change. During a record change, a nylon brush emerges automatically, as the tone arm passes over it, to remove dirt from the stylus.



automatic changers has suffered a shattering blow.

Zenith and scientists at CBS Laboratories developed it together. It is now available only in new Zenith stereo consoles, but undoubtedly will soon reach hi-fi equipment stores as a separate component



you can purchase for custom installation.

A quick look at the machinery suggests that the designers started out to make a professional turntable and tone arm that would meet hi-fi standards of low noise and minimum tracking force on the stylus—and then proceeded to automate it without detracting from its basic record-playing performance. Too often in the past, designers have lavished most of their skill on the changing machinery and accepted whatever playing performance happened to result.

The full-size turntable is 11 $\frac{1}{4}$ " in diameter and weighs four pounds. This follows professional turntable design in giving full support to 12" LPs and providing a flywheel effect to smooth out minor speed variations. A belt provides the final drive to the turntable—the method generally accepted as the most effective way to isolate the turntable from motor vibrations. The turntable platter is further isolated by soft rubber cushions between it and the main driven pulley.

The tone arm has an effective stylus-to-pivot length of 8  $\frac{9}{16}$ ". It is suspended on a knife-edge bearing and is precisely balanced by a lead counterweight. Although it tracks at only two grams, the balanced design keeps it from being jarred out of the groove even when you jump on the floor nearby. The pickup cartridge is on a floating mount that allows the cartridge to retract if the arm is accidentally dropped or forced against the record.

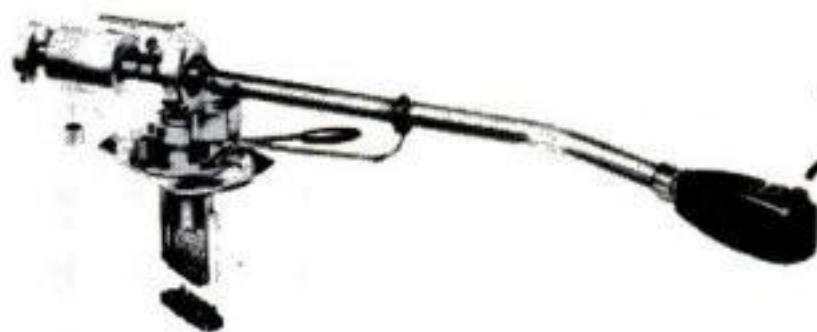
During several weeks of use-testing, I have been more concerned with how it *plays* records rather than how it *changes* them. The unique convenience features are pleasant to have, but I could live without them. Careful listening comparison with my professional turntable and tone arm has convinced me that this changer is practically equal in low turntable rumble, wow, and flutter. And, most important—in kindness to my records.

▶▶▶ Music throughout the house without special wiring will be available as an option on three new General Electric stereo consoles. The system consists of two basic units: a transmitter installed inside the console, and a receiver that can be plugged into an ordinary outlet anywhere in the house. The transmitter is a miniature FM broadcasting station but the signal travels through the house wiring instead of the air.



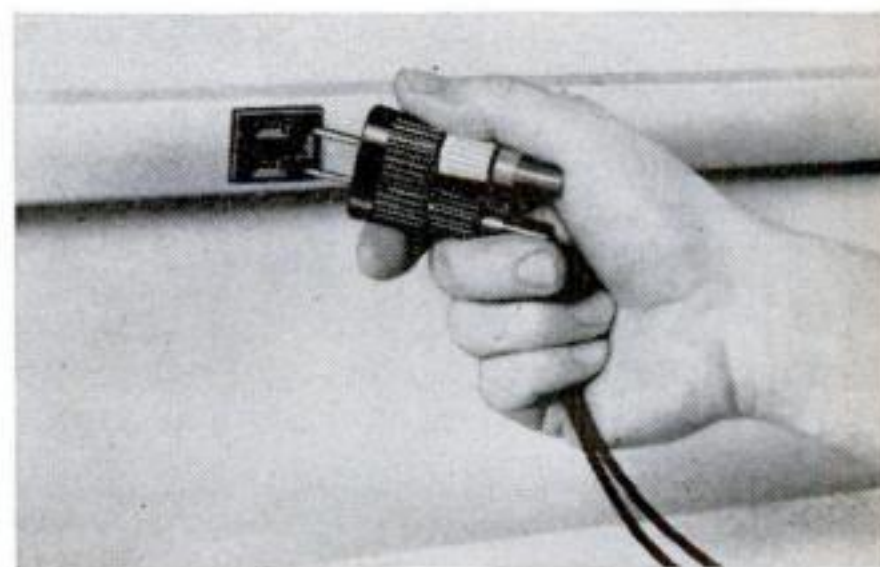
### From missiles to music

This new all-transistor stereo pre-amp uses modular construction like that in guided missiles. It is said to produce a musical tone quality unattainable with vacuum tubes. Harmon-Kardon makes it for \$250 as a kit; \$350 factory-wired.



### New tone arm won't "skate"

An antiskating device, a unique weight system for lateral and longitudinal balance, and a hydraulic control for lowering the arm are only a few of the features of this cost-is-no-object effort toward tone-arm perfection. Both overhang and height are adjustable after installation. It is imported by Shure Brothers, Inc. Price: \$89.50.



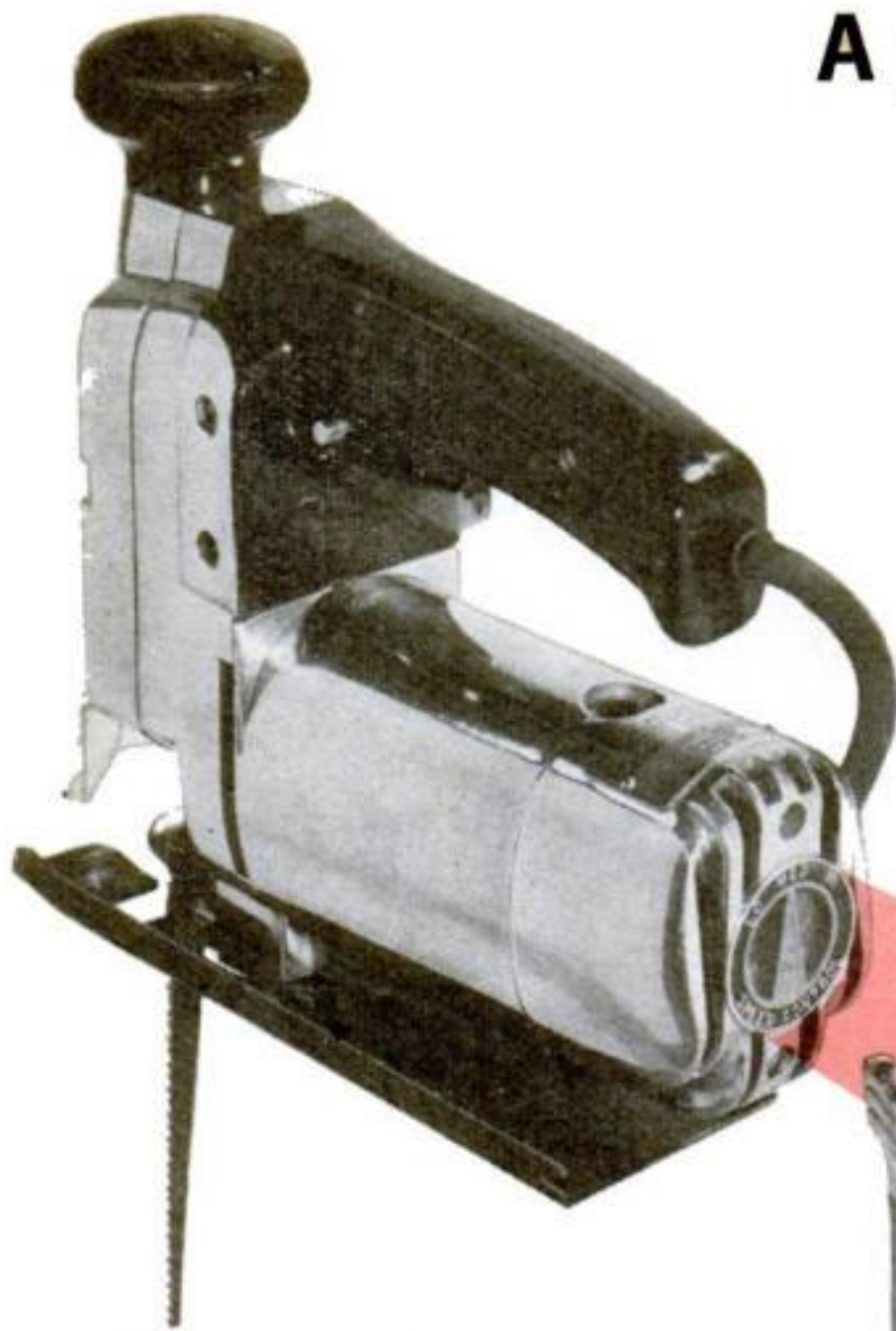
### New adapter for AC line connections

The dual adapter above provides quick, safe, binding-post-style connections at any receptacle. It is rated at 15 amps, 125 volts. Superior Electric, Bristol, Conn.



A personal-use  
report on—

# The First Space-Age Saber Saw

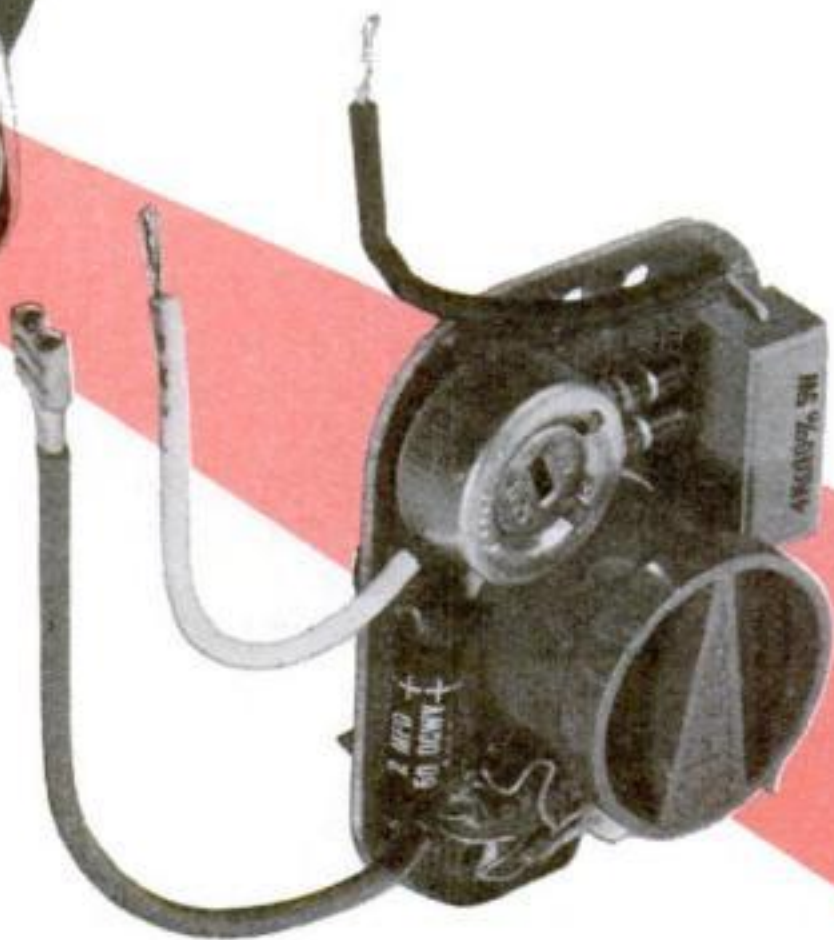


By Sheldon M. Gallager

**A**TINY electronic speed control, part of the modern magic of outer-space technology, has found its way into the home workshop. The control, shown above at right, weighs less than two ounces and is built into the back of a new saber saw. The result is a completely new concept in cutting tools—a saw that changes its speed to suit the material it cuts. With this electronic throttle, you can slice through steel plate, iron pipe, and heavy timbers with the same ease that you make delicate scroll cuts in thin veneers and sheet metal.

The saw is a new Craftsman, just announced by Sears, Roebuck. Its secret is the recently developed silicon-controlled rectifier—a supersensitive current-regulating device that's about to open up a whole new world of versatile tools and appliances.

What the rectifier does—and this is the important part—is vary the saw's cutting speed *without* reducing its cutting power. The control is similar to the one shown in *POPULAR SCIENCE* last month as a make-your-own speed regulator for plug-in shop tools. The difference, in this case, is that the device is built right into the tool.



*What variable speed does for you.* Each material you cut requires a different blade speed according to its particular toughness and thickness. Take heavy steel. Try to whack through at too high a speed and the heat from blade friction quickly ruins the blade's cutting ability and eventually snaps it in two. Soft metals like aluminum clog the teeth at high speed, and the blade stops cutting. Heat-softened plastics melt under blade friction and simply fuse back together again as fast as you cut.

None of these things happens with the new Sears saw, because you have a choice of three cutting speeds. There's a high speed of 2,700 blade strokes a minute, roughly equal to most conventional saber saws. You use this only for fast cutting of relatively soft materials: wood, composition boards, and some light-gauge metals.

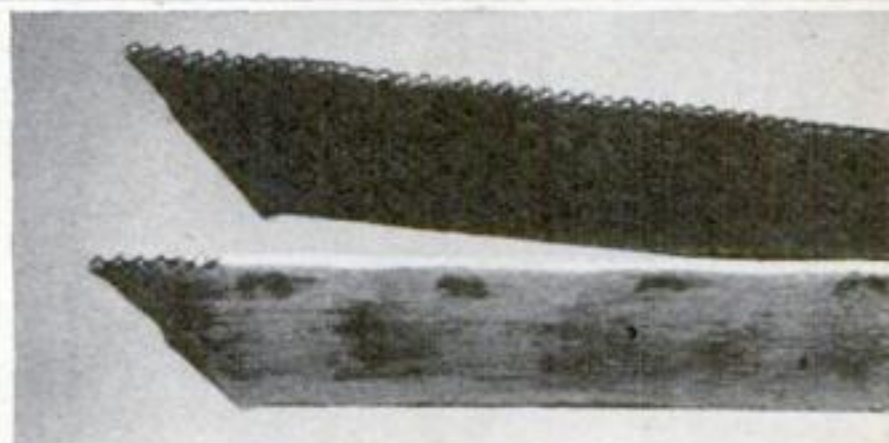
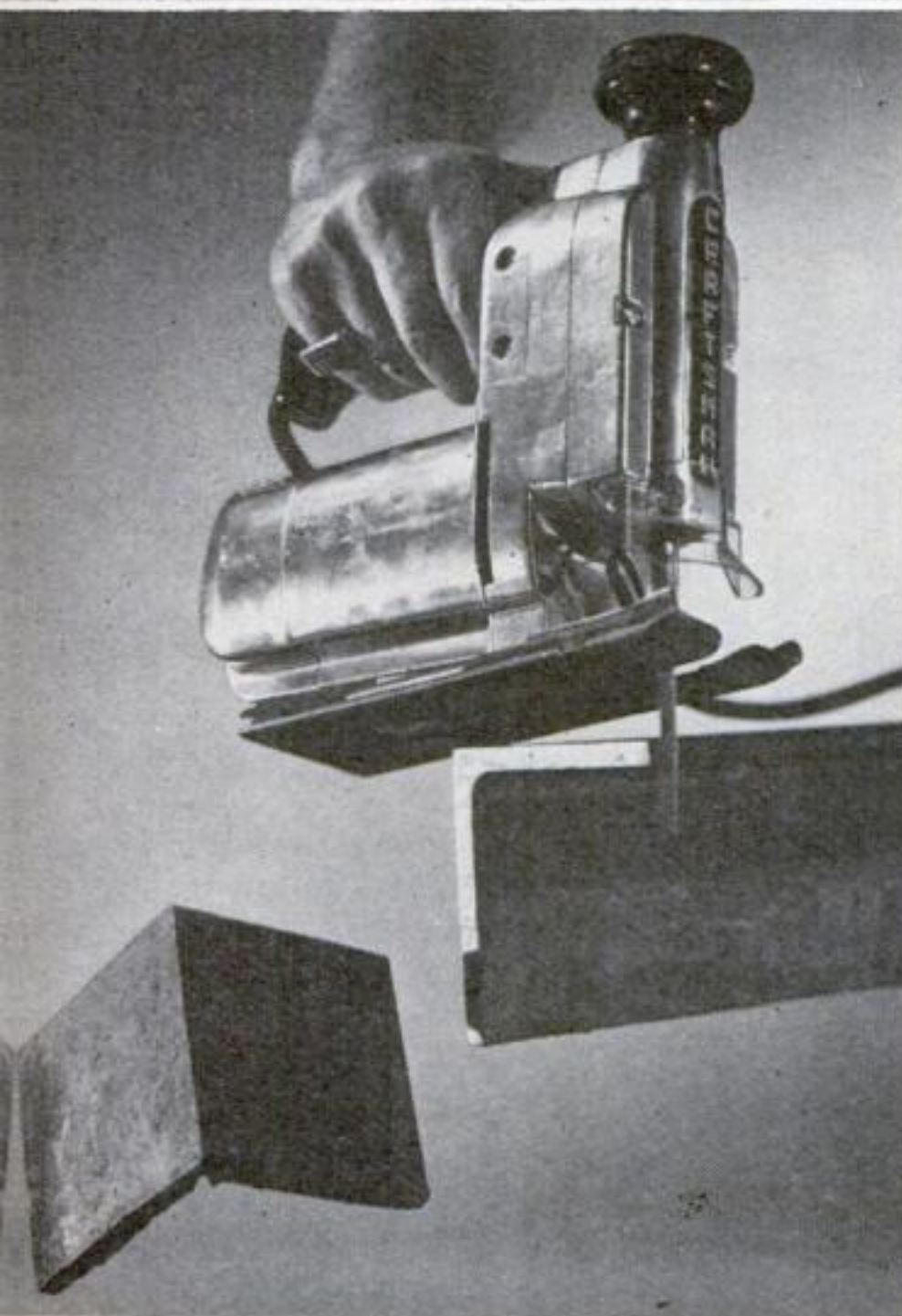
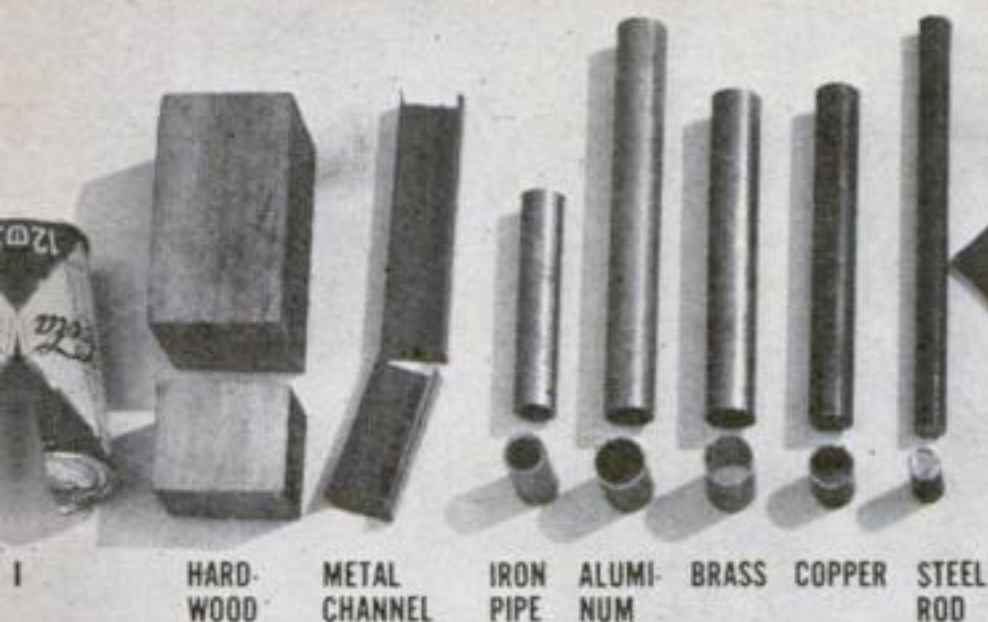
Throttle back to medium speed and you drop to 1,900 strokes a minute for munch-



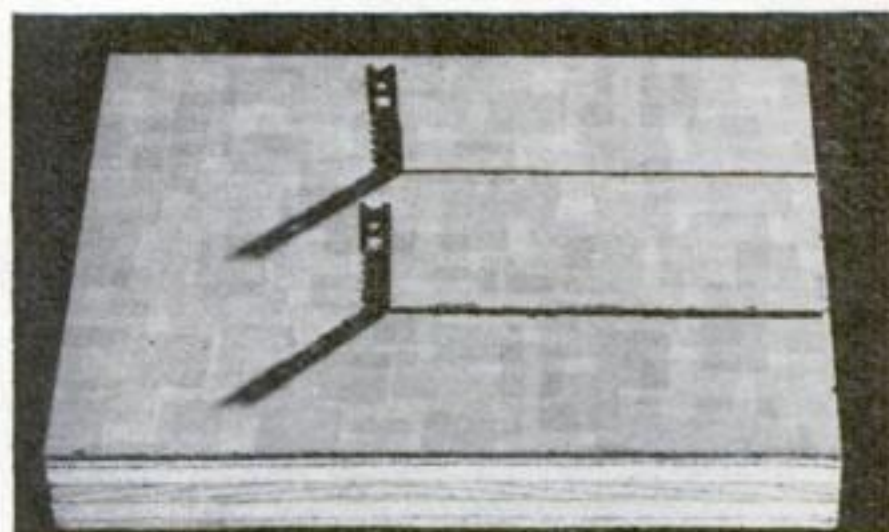
Three speeds handle just about any material

what's new

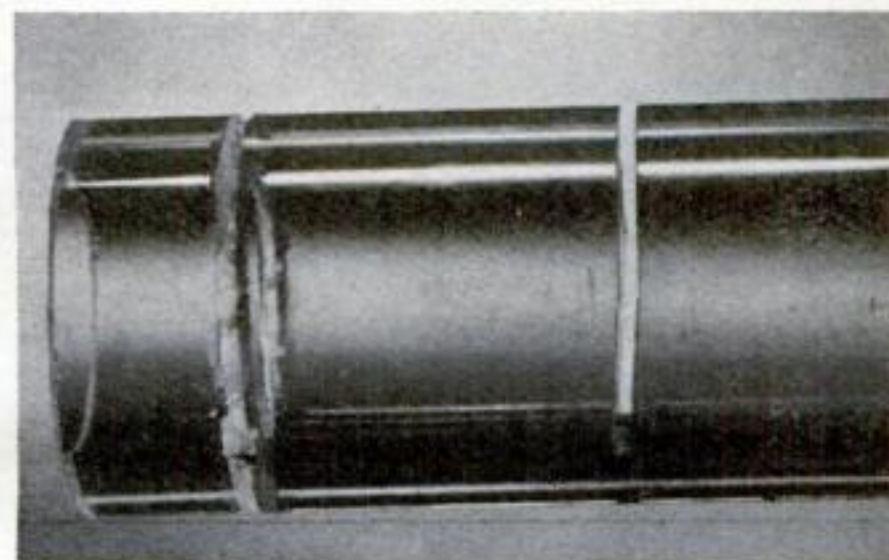
..... TOOLS



Look what happens with soft aluminum at high speed. Teeth (lower blade) clog, can't cut at all. At low speed, the teeth stay clean.



At high speed, a regular blade chips plastic laminate, as seen in lower cut. Thin, smooth cut was made at low speed with tapered blade.



Plastic tubing was cut all the way through at left, but fused together under heat of high speed. Low speed produced clean cut at right.

We had to try it to believe it. This 3"-by-4" steel angle, 1/4" thick, took the saw just under 10 minutes—a rate of almost 3/4" a minute.

ing through hardwoods, thick steel, and soft nonferrous metals like aluminum and brass. Shift into low and you get a rugged 1,000 strokes a minute for slogging through plastics and tough cast iron.

*How the speed control works.* The old

[Continued on page 186]



what's new

.....TOOLS

# You Dial Any Speed on This Drill



**T**WIRL a small knob on the top of this new Disston drill and you can get any speed you want from a piercing 2,000 r.p.m. down to a rugged 600 r.p.m. By adjusting the speed to suit the material, you can drill anything from delicate laminates to tough steel and concrete without burning the bit, stalling, or splintering the material.

The built-in speed changer is based on a silicon-controlled rectifier similar to the one used in the new Sears, Roebuck saber saw shown on the previous pages. The rectifier, by automatically speeding up the motor when it's under a load, makes it possible to run the drill at any speed and still get full power. At the wide-open 2,000 revs, you have high speed for thin or brittle materials and small bits. For large holes, you can drop down to a medium speed. Throttle way down to 1,000 or 700 r.p.m. and you can chew through hard materials like steel and concrete.

The drill has a  $\frac{3}{8}$ " chuck, but, because of its variable speed, is said to handle the jobs of  $\frac{1}{4}$ " and  $\frac{1}{2}$ " drills as well. Its 4.1-amp motor develops  $\frac{1}{2}$  hp. no matter what the speed.

The speed-control knob is conveniently located at the top of the pistol grip where you can reach it with your thumb without letting go or stopping the drill. For quick reference, the knob is numbered to correspond to eight different speed settings. A handy chart on top of the housing tells you which number to dial, depending on bit size and type of material.

The Dial-A-Power Drill will sell for about \$70 from Disston Div., H. K. Porter Co., Porter Bldg., Pittsburgh.





# HE'LL LOVE THE FLAVOR...AND EVERYONE WILL LOVE THE AROMA!

When Dad lights up a pipeful of HALF AND HALF, the people around him enjoy it almost as much as he does. That's because no other pipe tobacco has such a delightful aroma—and such a distinctive taste.

HALF AND HALF is a mixture of choice aromatic tobaccos . . . specially selected and blended for mild taste and friendly aroma. So this Christmas give your pipe smoker HALF AND HALF. Everyone enjoys the aroma.

©THE AMERICAN TOBACCO COMPANY



**MEMO TO SANTAS!**  
Show this to your better half—  
She'll love the aroma of  
HALF AND HALF!

**A CARGO OF CONTENTMENT IN THE BOWL OF ANY PIPE!**



# NEW!



Pistol grip shown is one of a complete set of optional movie aids specially designed for this new, advanced Kodak movie camera.



# KODAK Electric 8 Automatic Camera



**BATTERY-DRIVEN!** No winding—ever. Four powerful manganese alkaline batteries—penlite size—drive the camera motor for you. You can keep shooting as long as action lasts with no chance of a scene-spoiling slowdown in power. One set of batteries will drive up to 10 rolls of film through camera. A signal in the viewfinder gives you long-range warning when batteries need replacing.



**DROP-IN LOADING!** New KODAK DUEX 8 Cassette speeds loading. You place regular 8mm roll film in the cassette in seconds. Drop cassette into the camera and it's loaded! When you finish the first side of the roll, just turn the cassette over to shoot the second side. (You can do it faster than a football team can huddle!) Pre-load several cassettes to film a whole game or other continuous action.

## You're always ready for action!

The new KODAK Electric 8 Automatic Camera is ready to go the distance in any action. Ready to whirr into action as fast as you can put it to your eye.

No winding! It's battery-powered. No lens setting. An electric eye automatically adjusts the super-fast  $f/1.6$  lens to the light.

For extra versatility you can lock the lens at any setting. Set the meter for intentional under- or overexposure for spe-

cial effects. A built-in filter lets you use the same roll of Type A KODACHROME Film indoors and outdoors.

Isn't this the kind of movie camera you've always wanted to own . . . a camera always ready to capture the action and color that's now passing you by? See it soon at your Kodak dealer's. Own it in time to save your Christmas in colorful movies! With hand strap, one cassette, less than \$100. Batteries extra.

*Price subject to change without notice.*

**EASTMAN KODAK COMPANY, Rochester 4, N.Y.**

Enjoy Walt Disney's "Wonderful World of Color" Sunday evenings, NBC-TV

**Kodak**  
TRADE MARK

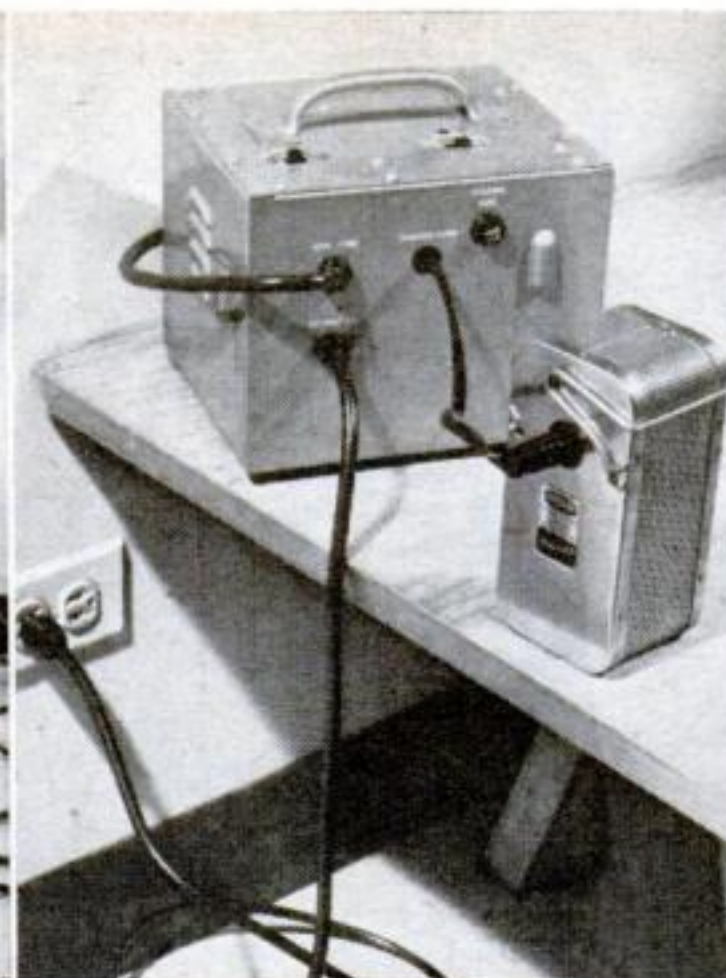




OUTDOORS ON BATTERY



INDOORS ON HOUSE CURRENT



RECHARGING THE BATTERY

## Now: A Battery Drill for 110-Volt AC

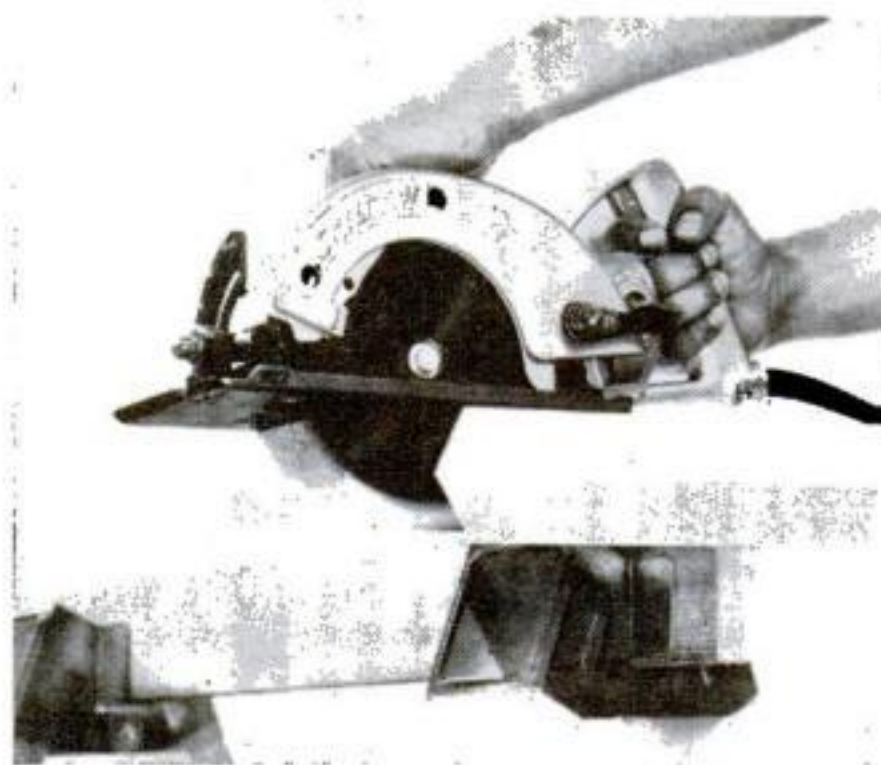
Remember our prediction last July of a battery-powered drill that you could also plug into a wall outlet? It's here. A new accessory converter allows you to run Porter-Cable's battery drill on house current indoors. Outdoors, you switch to a small battery pack that clips to your belt.

The idea—a smart one—is that you don't waste your battery when you have access to 110-volt AC. The converter, priced at about \$40, also contains a battery charger. The drill, available in  $\frac{1}{4}$ ",  $\frac{3}{8}$ ", and  $\frac{1}{2}$ " sizes, sells for about \$70. Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh.



### Two-way spot-welder solders, too

This pistol-grip spot-welder quickly turns into a soldering iron. Simply slip the electrode holder out of the gun and use it separately with a soldering tip. For welding, the gun's trigger advances or retracts the electrode. Both will work on any standard AC or DC power supply. Price is \$47.50. Arcair Co., Lancaster, Ohio.



### "Backwards" saw for better visibility

Notice anything odd about this portable circular saw? Its blade is to the left of the motor instead of the usual right. This, say the Skil folks, puts the blade nearest you so you can see the cut more easily. The heavy-duty saw has worm drive and a  $2\frac{3}{16}$ " cutting depth, will sell for under \$100. Skil Corp., 5033 Elston Ave., Chicago.

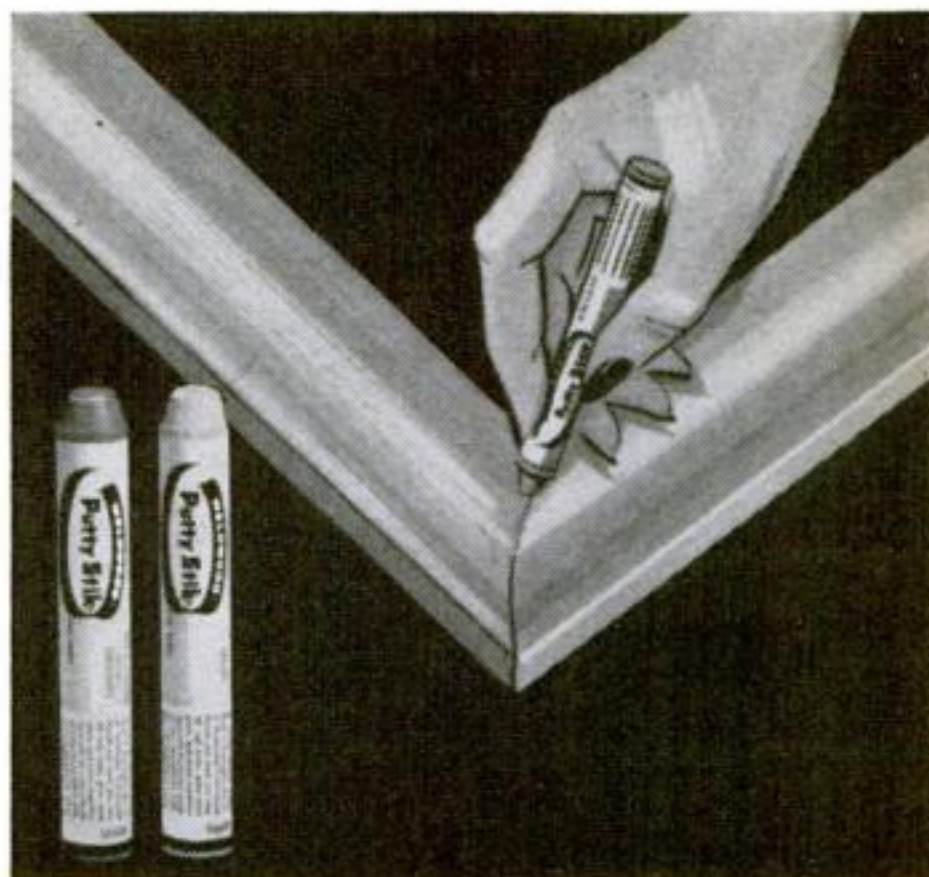


# REPAIR BOOTS—OR FILL A MITER JOINT

with a Weldwood Fix  
and Finishes shelf  
in your workshop



**Fix the family's foul weather gear.** It's easy to mend tears and cuts in rubber or plastic boots—rain coats, too—with Weldwood® Contact Cement. Ideal for bonding leather, cloth, and semiporous surfaces, too.

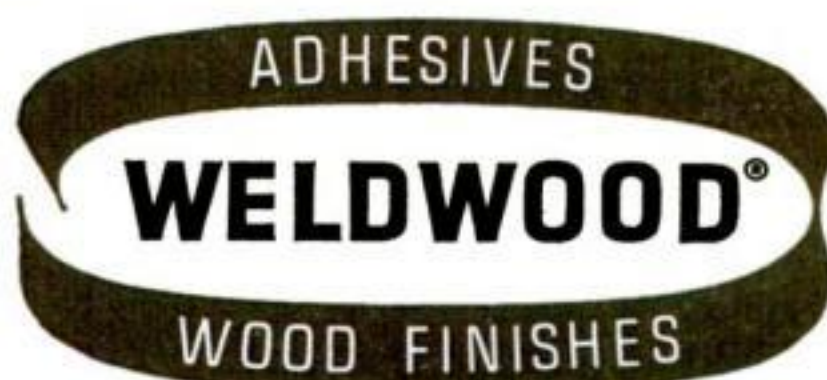


**When a miter joint gapes slightly, don't despair.** Complete the piece, apply the finish, and then fill the crevice with a Weldwood Putty Stik® of the right color—25 wood colors available.



**Restore an heirloom.** Bring out the rich color and grain of fine old wood with Weldwood Satinlac®. Remove old finish completely, sand, apply Satinlac. Dries quickly—apply subsequent coats in 4 hours.

You'll have more fun using your workshop when you're prepared, and ready to go when jobs come up. Put in a stock of the Weldwood products shown on this page. They're basic materials for the great majority of gluing, repairing, and finishing jobs. Get yourself set for this winter's jobs and projects. Pick up the Weldwood products at your local lumber yard or at your paint or hardware store.



*Products of United States Plywood,  
55 West 44th Street, New York 36, N.Y.*



# Gus Puts the Brakes on a Fast Deal



*"I'd better find you other transportation," Gus said. "You take out your harp while I phone."*

**By Martin Bunn**

**G**US stood in the door of the office at the Model Garage. "Not today," he said firmly. "Nor tomorrow or any other time."

The sharp-featured salesman facing him pushed his hat up a bit and planted a foot squarely on the desk chair.

"Look here, Wilson, you don't run this place for your health. Gotta look out for Number One, or who else will? Now here's a perfectly good brake fluid for two-fifty a gallon. Why pay six?"

"Because," retorted Gus, "I've got to know what I'm getting."

"I'm telling you—first-class stuff," the salesman countered. "Can't tell the difference from a brand-name variety."

"But my customer might," said Gus.

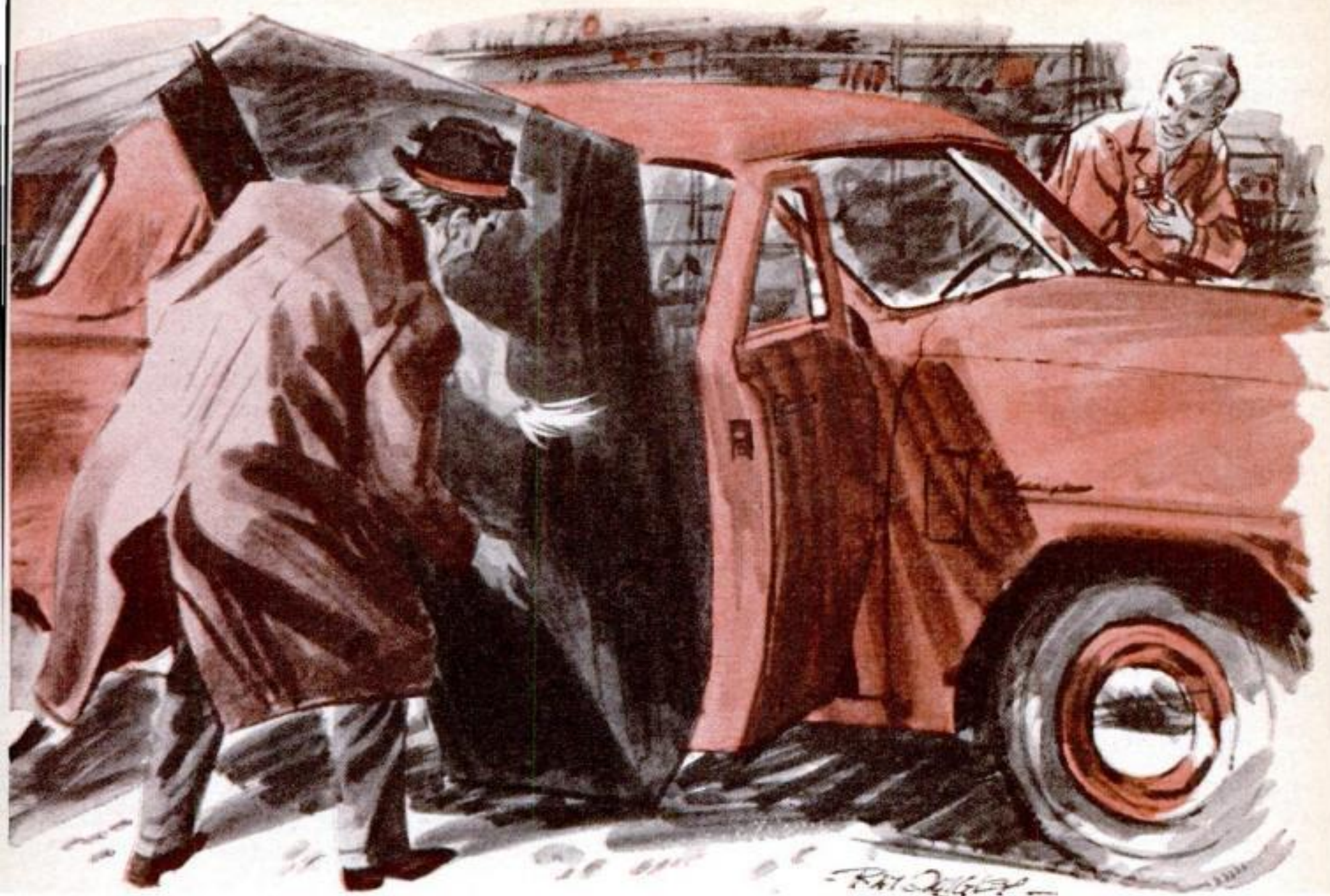
"Them jerks? Most drivers don't care what you pour into their crates, so long's they run. Besides, by the time any trouble shows, they figure it's wear and tear, so you get a new job out of it."

"Get lost," said Gus, turning away.

The man hitched down his plaid vest. "Look, I don't usually tell Sears about Montgomery-Ward, but"—his voice sank to a confidential whisper—"know who's been buying this stuff from me almost a year? Ideal Garage, down in Newton. That's a good shop, does more business than you—"

Gus swung around, grabbed the man by his coat collar and the seat of his pants, and goose-stepped him rapidly out the door.





"Next time," Gus promised with grim emphasis, "I won't be so gentle. Get!"

*Grinning widely*, Gus's helper rolled out from under a car as Gus stalked back in.

"Good floor show from here, Boss."

Gus merely grunted.

"He's a crumb, sure," Stan went on. "But if Ideal does buy that stuff, it can't be so bad. Lot cheaper, too."

"Anything can be sold cheaper by somebody," returned Gus. "First it was war-surplus fluid meant for airplane hydraulic systems. That played hob in cars. Now creeps like this sell home-brewed fluid, cardboard oil filters, and other just-as-good stuff."

"A filter that goes to pieces sure could clog oil lines," said Stan. "But we've always used a standard brake fluid, so I don't know what could go wrong with other kinds."

"Some cheap fluids are just too volatile," explained Gus. "When the brakes get hot—say when you're tooling down a mountain grade—the stuff boils and forms vapor. That could leave you with a sponge instead of a brake pedal. I'd hate to lose a customer that way."

"Some of today's heavy cars develop so much brake heat they call for heavy-duty fluid, one with a higher boiling point. Use ordinary fluid in one of those and you're asking for brake trouble."

"Bootleg fluids can be tricky in other ways, too. I've got a stunt to show you what can happen if they have petroleum products in 'em, but it'll wait till I get back from town. Did you take care of Mosshart's car?"

"That screwball '51 with only half a front seat in it?" asked Stan. "The one we put up on blocks last summer? Sure, I let it down, checked oil and water, and put in the battery we'd kept on charge here. She started up fine, first try."

"Good work." Gus went briefly into the stock room and toward the back door, pausing to drop something into the tank of degunking fluid on his way out.

A *laboring, overstrained engine* brought Stan to the door of the shop some time later. He had an uneasy premonition when he saw that it was Mosshart's car, barely moving. The two-door sedan crawled up the shop driveway and shuddered its way



into the garage. Stan hastily directed the driver to a vacant spot on the floor. Steam poured from the overflow as the driver shut off the overheated engine and got out.

"You—you—" spluttered Mosshart, a tall, slender man with amazingly long fingers. "I pay you to lay up my car while I am in Europe six months. I pay you to come put it into condition to drive again today. Tonight I'm playing with the City Philharmonic, so I start for my most important rehearsal. What happens? My engine has no power. The car crawls. It boils. Even my brakes feel wrong. But with such an anemic engine who needs brakes?"

Stan opened the hood and cautiously loosened the radiator cap to release pressure. He found the oil level just what it had been in the garage. But when he tried to push the car within reach of a water hose, it wouldn't budge.

The hand brake was off, the shift in neutral. Stan stepped on the brake pedal. It was stone-hard, with no free travel at all.

"Your brakes are locked," he said.

"Impossible!" snapped Mosshart. "Before I left, I had new linings put in, the drums trued, and the wheel cylinders rebuilt. It's

an old car, but specially arranged to carry this."

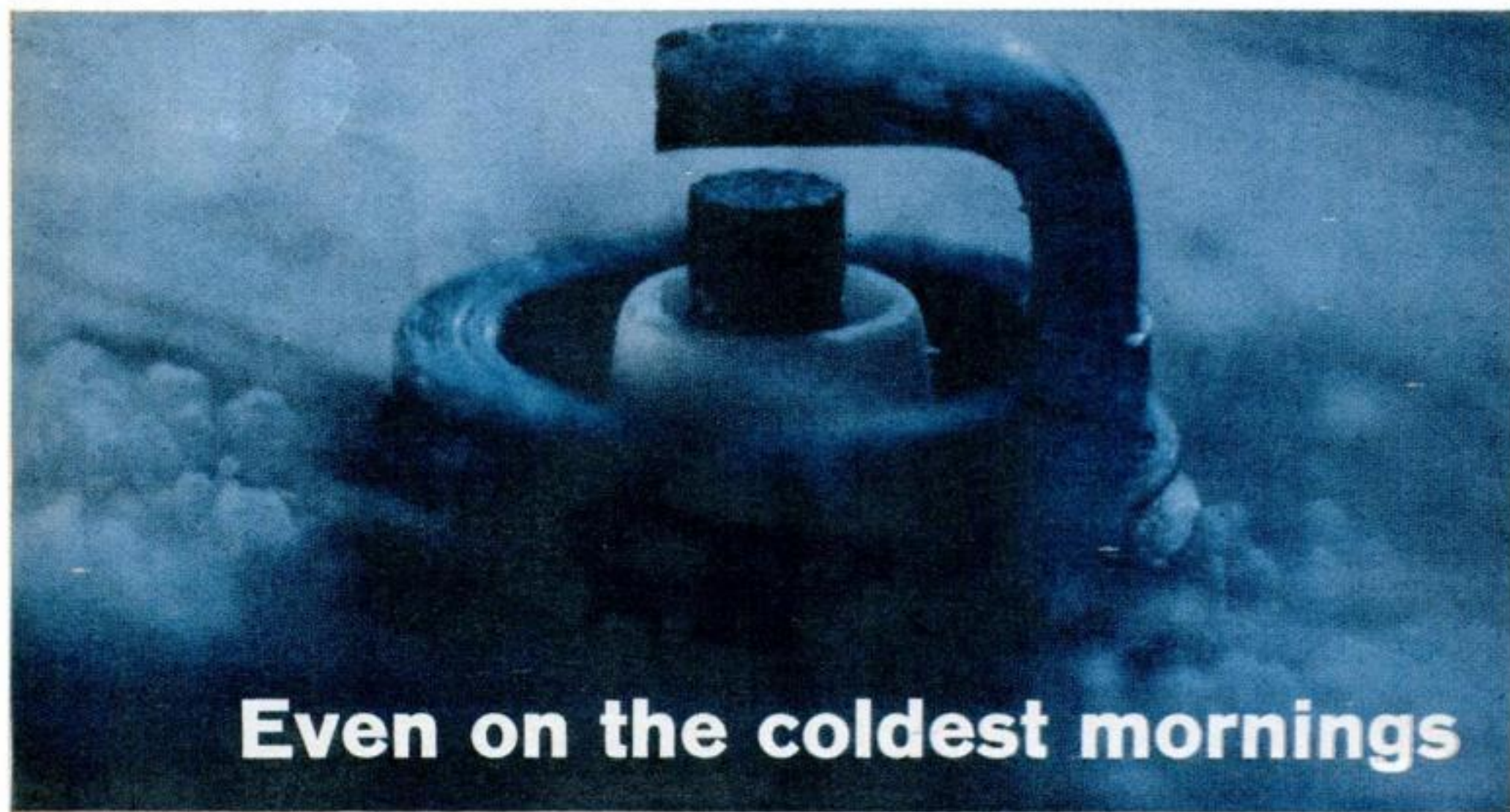
Opening the right-hand door, he revealed a huge black instrument case of roughly triangular shape. "My harp, a magnificent instrument. And it won't fit into any ordinary car or taxi. You'll have to fix this one at once!"

Stan breathed in deeply and took a chance. "Looks like the rubbers swelled in the master cylinder and they're blocking the relief port. The fluid can't get back from the wheel cylinders, so it holds the brake shoes out. Happens in old cars sometimes."

Mosshart flexed his fingers nervously. "So fix it. And in a hurry!"

Uneasy because he'd made a snap judgment, Stan nevertheless phoned for a master cylinder to be rushed over. By the time it arrived he had the old one off. He filled and bled the replacement on the bench, hooked it up, and bled the wheel cylinders.

Little air came out. He filled the radiator, started the engine, and drove out. His uneasiness returned when he felt the brake pedal go hard after the first inch.



## Even on the coldest mornings

Regardless of the weather, you get fast starts with AC Fire-Ring Spark Plugs. AC's potent spark provides the punch to get maximum power from every drop of gasoline. What's more, the searing heat at the exclusive AC tapered insulator tip burns away harmful carbon deposits before they have a chance to form — the insulator



The car was so logy he turned back after two blocks. When he had urged it back into the shop, the brakes were undoubtedly again locked, and Stan was relieved to see that Gus was back.

Evidently Mosshart was telling him his troubles, for after watching the car limp in Gus turned back to the customer.

"Since you've told me how urgent it is for you to reach the city, Mr. Mosshart," he said, "I'd better find you other transportation. Your car needs more work. You take out your harp while I make a phone call. I don't own a station wagon, but I think I can fix you up."

*With the deftness of habit* Mosshart slid out the huge instrument case. Then, glaring at Stan, he lugged it outside as rapidly as his bulky burden would permit. Gus followed, and soon Stan heard two doors slam and a car drive off.

Stan had jacked up the front end of Mosshart's car. He bled one wheel. To his surprise, it remained locked. So did the other.

"Did you bleed them before putting in that master cylinder?" Gus asked the puz-

What's this a photo of?



ANSWER: Not bushel baskets full of leaves or bowls of crunchy cereal. They're cigarettes in the pack.

zled Stan on coming back into the shop.

Stan shook his head. "Should have, but he was in a tearing hurry, and as I could work on the car where it stood, I barged ahead. Sure goofed."

"If it's what I think," said Gus, "he

CONTINUED

## ACs give you hot starts

AC SPARK PLUG THE ELECTRONICS DIVISION OF GENERAL MOTORS

actually cleans itself. Then there's AC's exclusive precision-ground knurled center electrode. Its sharp edges give you a crisper, more evenly distributed spark for more power and increased economy. The next time you install a new set of spark plugs insist on ACs. The Hot Tip is just the ticket for fast starts on those cold days.



**FIRE-RING  
SPARK PLUGS**



needs lots more than a new master cylinder. Let's pull the wheels."

It took more than pull. The shoes gripped the drums so hard they had to be tapped off. Gus removed the shoes and the rubber dust covers on one cylinder. Both pistons could be seen well out from their normal "off" position. He removed the wheel cylinder and with a soft mallet drove out both pistons. They were blotchy with a gray-white deposit.

"No wonder they jammed," muttered Stan. "But how come they're covered with this stuff?"

"It's corrosion that builds up on alu-

out a brake system with kerosene or gasoline.

"Bet you'll find all the other wheel pistons on this car corroded the same way. Standing six months, the fluid had plenty of time to act. If the car had been used, the pistons might not have jammed, but they'd be etched and pitted all the same. Better order four new wheel-cylinder assemblies."

Corrosion had indeed jammed the pistons in the other three wheel cylinders also. Stan removed them, drained out the old fluid, and flushed the entire system with pure alcohol. Then he installed the new cylinders, which came with pistons and dust boots in place. Refilling the system with good fluid, he bled all four wheels. When he took the car out for a thorough road test, the brakes worked perfectly.

"So it was brakes, not my engine?" boomed Mosshart when Gus explained the trouble next morning. He nodded at Stan. "I owe this fellow an apology, and that other garage—Ideal—it owes me one, eh?"

"Ideal!" snapped Stan. "Gus, maybe that salesman told the truth for once."

"When Ideal gets the claim for what this job costs," said Gus, "that fellow will be out a customer. Sorry I couldn't get you better transportation

yesterday, Mr. Mosshart, but that case of yours—"

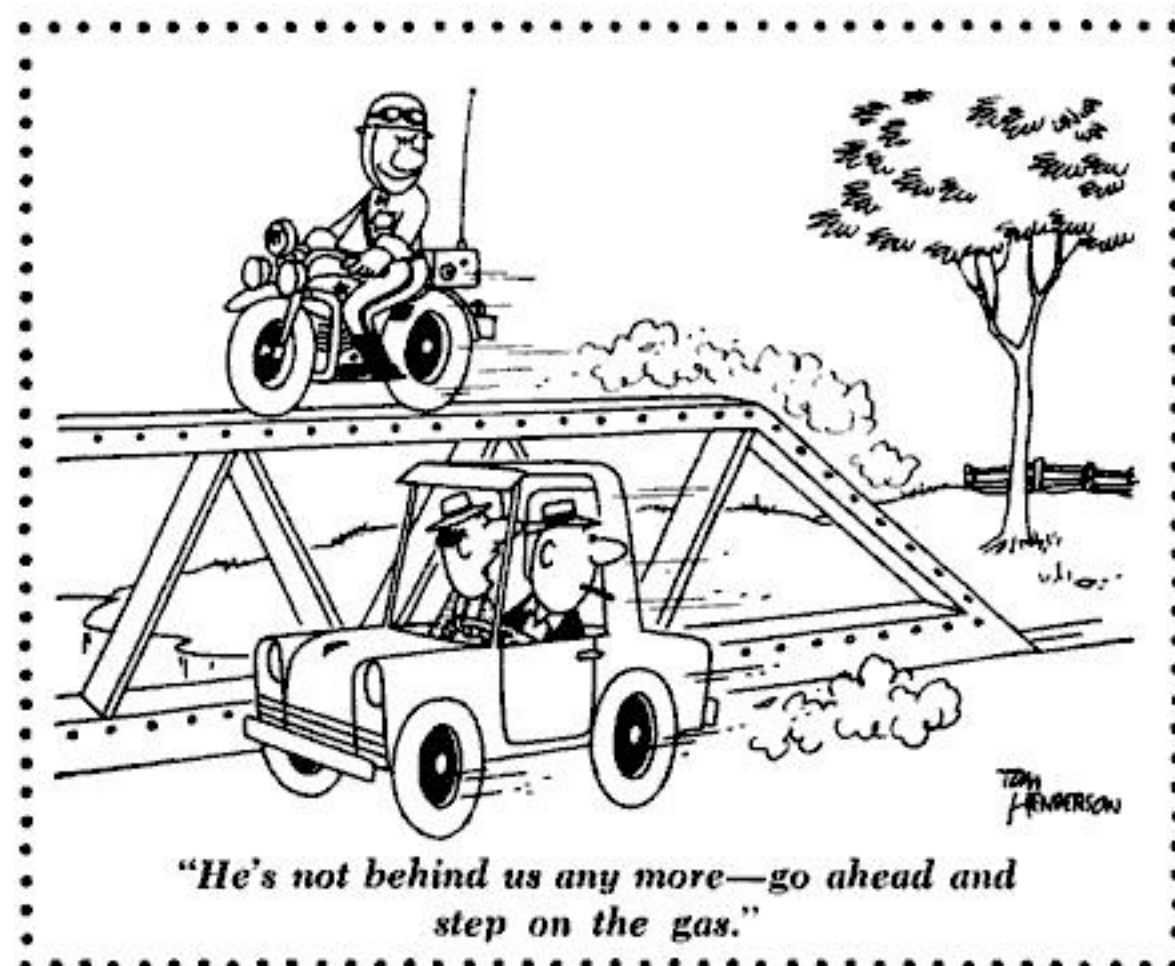
Mosshart waved his long fingers. "No matter. I got to rehearsal. And I played wonderfully last night. It brought me luck, riding in that car." He laughed loudly.

"What did you get to haul that thing in, Gus?" asked Stan.

"Oh, I happened to meet Joe Safford uptown yesterday," replied Gus. "He said he was going to the city to bring back a special—er—container. So when this emergency came up I asked him to give Mr. Mosshart and his instrument a lift."

"Mr. Safford?" burst out Stan. "But Mr. Safford is a—"

"A very obliging man," finished Mosshart. "When he let me out, it impressed the Maestro very much. Bet it was the first time a harpist ever arrived at Symphony Hall in a beautiful big, black hearse!" ■■



"He's not behind us any more—go ahead and step on the gas."

minum in contact with salt or acid—which might be present in some phony fluids. Nowadays pistons are anodized to resist corrosion better, but they weren't in '51—and you still take a chance of trouble with poor fluid."

"This sure proves it. Hey, this morning you said you'd show me, but how could you have known—"

"That Mosshart's car would be our guinea pig? I didn't. But go fish out what's in our degunking tank."

Stan sauntered back a moment later with the small round black object Gus had dropped in the tank.

"It's a dust boot with the size marked—one inch. But it's twice that big."

"Swelled up in that petroleum-base cleaner," said Gus. "Some cheap fluids have petroleum products in them. So there's another reason not to use them—or to flush



# Here is the news that makes **RAMBLER '63 THE NEW SHAPE OF QUALITY!**



**ALL NEW!** Come see and drive the most beautiful Ramblers ever built—the all-new 1963 Rambler Classic Six and the 250 HP Rambler

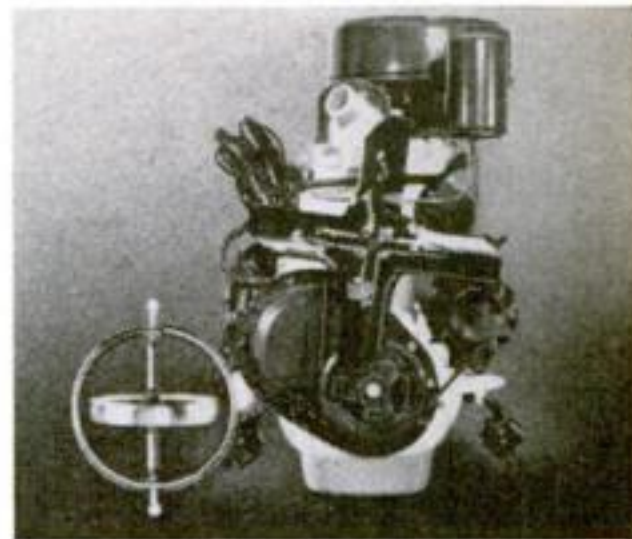
Ambassador V-8. Built a brand-new way, they look longer but aren't. Nearly 3" lower, yet easier to enter. Full room for six 6-footers.



**ALL NEW!** Twin-Stick Floor Shift with Instant Overtake for sports-car action. Available.



**ALL NEW!** Chair-Height Bucket Seats with smart, handy Console. Available.



**ALL NEW!** Tri-Poised Power—vibration-free ride. Engine is seated in deep rubber!



**ALL NEW!** Advanced Unit Construction. Major breakthrough in car construction—massive one-piece uniside of galvanized steel (white above). Stronger, safer, longer lasting.



**ALL NEW!** Curved side windows as in \$6,000 cars. Cut wind noise, add new beauty.

**AMERICAN MOTORS — Dedicated to Excellence**



## Teaching Machines—Do They or Don't They?

[Continued from page 62]

his own pace, may help in solving this.

Industrial leaders, too, are looking to teaching machines to help solve one of their toughest problems: displacement of workers by automation. And programmed instruction may turn out to be just the ticket.

**In the home.** Teaching machines and programs for home use are now available, too. Doubleday puts out a series of TutorTexts that are available at book stores. And several companies sell teaching machines door-to-door.

Correspondence schools are on to them, too. International Correspondence Schools tried them on 500 students, reports that students didn't learn faster—but did retain what they had learned better.

In spite of the promise—and zooming popularity—of programmed instruction, there are still a good many unsolved problems. Main one: turning out enough good programs. Without a top-notch program, a machine is just scrap iron.

Bad programing has probably contributed to the few out-and-out failures racked up by programmed instruction so far. One school in Illinois, for example, was so unhappy that it called off a trial program at midyear. Teachers called it untidy, monotonous, too bulky, and hard to review. The Spiegel Company of Chicago installed a program to train salespeople, and eventually dumped it.

But in spite of a few unhappy experiences, many programmed-instruction users report fine results. And it's a good thing they do. For like it or not, we'll probably be forced into large-scale use of teaching machines in coming years. Authorities estimate that by 1970 we'll have 50,000,000 children in school, 10,000,000 students in college. More teachers might be needed than we could supply.

**The future.** If expansion of the teaching-machine industry continues at its present rate, it will be ready when the time comes. Although the first tentative programs were launched only a few years ago, already pupils in some 4,000-6,000 schools are studying everything

from arithmetic to zoology by machines and programed texts.

Crowder estimates that by 1965, half of all students will be using teaching machines, at least for a course or two.

How do students react? At first, they're eager to get their hands on the machines. Later, the whole process becomes routine. But one youngster's back-handed compliment may show that the educational value is far from routine. "I don't like them," he said. "They make me think too hard." ■ ■

## PS teach-yourself chase

**STARTS ON PAGE 60**

**M**

Your answer was:

Yes, we have proven our theorem.

I'm afraid we're not done yet. We have proven that if  $n = 2m + 1$ ,  $m$  being any integer, then  $n$  is odd and we are trying to prove that  $n^2 - 1$  is divisible by 8. We have shown that this is equivalent to proving that  $m(m + 1)$  is divisible by 2. We have proven that  $m(m + 1)$  is divisible by 2 if  $m$  is an even number. But we still have to consider the possibility that  $m$  is an odd number, don't we?

Now return to Box U, Page 176, and choose another answer.

**N**

Your answer was:

No, our theorem does not say that  $(n^2 - 1)$  is divisible by 8 if  $n = 6$ .

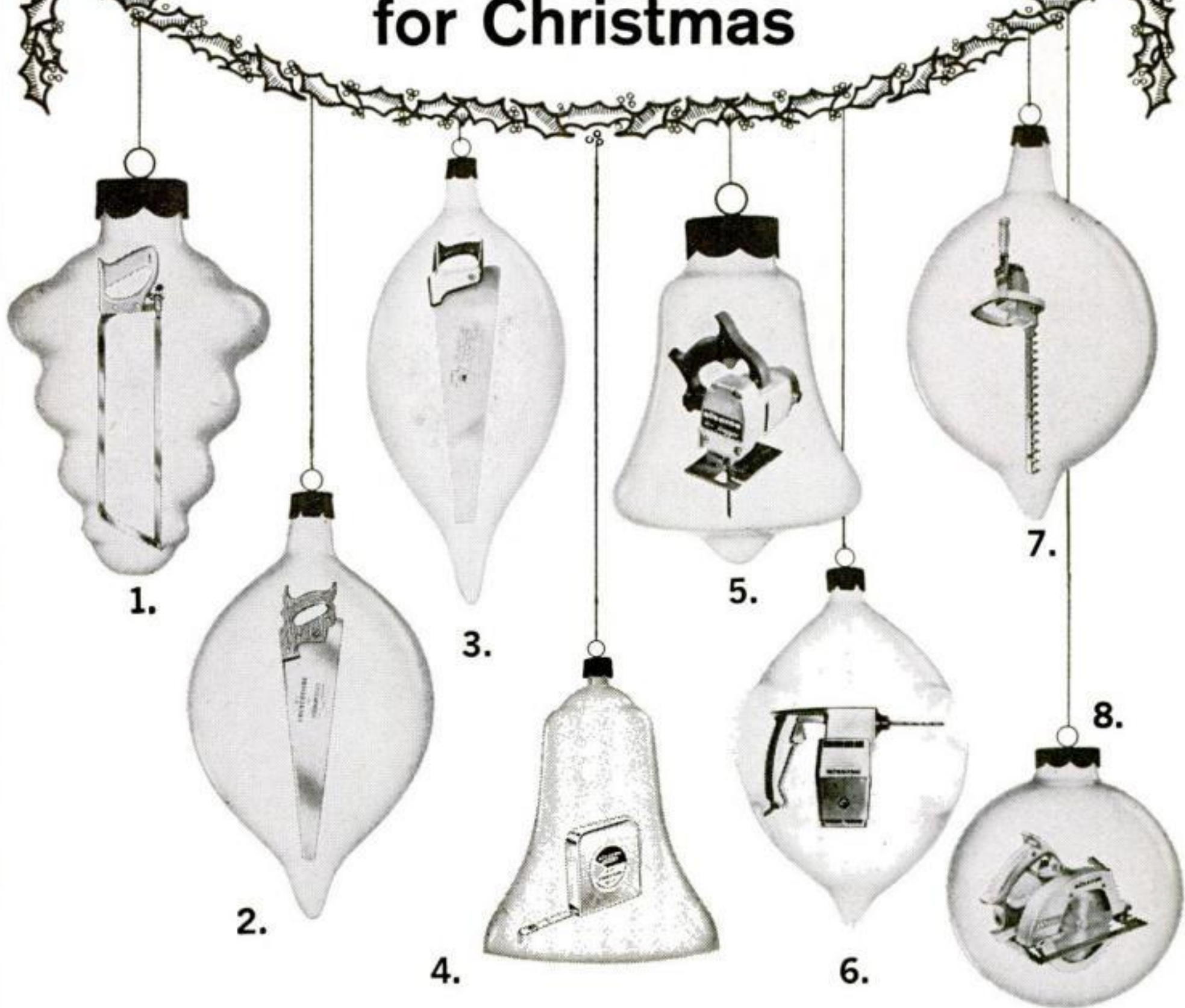
You are correct. The theorem says that if  $n$  is an odd number, then the number  $(n^2 - 1)$  is divisible by 8. But it says nothing about what happens if  $n$  is an even number, such as 6.

The proof of our theorem depends on  $n$  being an odd number, so first we will try to express the fact that  $n$  is odd. If the number  $m$  is any integer, even or odd, which expression below says that  $n$  must be odd?

	BOX	PAGE
$n = 2m + 1$	K	73
$n = 2m$	V	179
$n = m + 1$	Z	184



# For giving or getting... Quality **DISSTON** tools for Christmas



Buy now for Christmas and save. Your dealer has all these Disston gift tools at special, Christmas money-saving prices. 1. All-Purpose Kitchen Saw . . . \$1.80. 2. Countryside Hand-saw . . . \$4.30. 3. D-100 Handsaw . . . \$12.98. 4. Pocket-Handbag 6-foot Steel Rule . . . \$1.19. 5. DAGGER Sabre Saw with carrying Case and 9 Blades . . . \$54.50. 6. DIRK 1/4-inch Power Drill . . . \$26.95. 7. DRAGON Shrub and Hedge Trimmer with 62-foot Cord . . . \$44.50. 8. DISCUS 6 1/2-inch Circular Saw with Carrying Case and Blade . . . \$54.50.

See these DISSTON CHRISTMAS SPECIALS at your local hardware, building supply or department store. Disston—Master Toolmaker since 1840.

Disston Division, H. K. Porter Company, Porter Building, Pittsburgh 19, Pa.



**DISSTON DIVISION**  
**H. K. PORTER COMPANY, INC.**



# WANTED

## (most) for Christmas

"Here's just a pair of the best doggone gifts ever branded. Better see 'em all, Pardner!"

"A real steal!"



12 times faster than hand sanding. Ball bearings. Powerful Millers Falls-built motor. Ideal for cabinetmakers, craftsmen, painters and hobbyists. 4500 non-scratching orbits per minute.



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MILLERS FALLS CO., Greenfield, Mass.

### Keeping a Date with Venus

[Continued from page 47]

bowl antennas. One transmits commands to Mariner. The other receives its reports.

To give Mariner a command—which may be either for execution at once or later on signal—JPL sends a roll of pink perforated tape to Goldstone. An engineer there presses a button, and the transmitting bowl flashes the message to Mariner. Thus the spacecraft was successfully put through the most complicated maneuver any ever performed—rolling and pitching into position, and briefly firing a tiny rocket carried aboard—in a delicate midcourse correction assuring a bull's-eye on Venus.

Mariner itself is talking practically all the time. Over and over, it transmits 20 seconds of data from its instruments, then 17 seconds of "engineering" reports about itself: its temperature inside and out, its solar panels' output of electricity, and so on.

On sighting Venus, Mariner will switch off its engineering reports and devote every second of the fly-by to transmitting observations of the planet—across 36,000,000 miles of space. So planned is the timing that Goldstone is the station due to receive them.

*Tom-toms and tape.* The voice of Mariner, reporting from space, sounds like the beat of distant tom-toms. But the eager listeners at Goldstone are not depending on their ears to transcribe and preserve the priceless messages.

Mariner's drumlike signals are being recorded constantly on magnetic tape—five miles of it daily. Most prized of all, if hopes are fulfilled, will be 800 precious feet of tape, fruit of the 41-minute Venus fly-by.

At Pasadena, machines convert the magnetic-tape recordings successively into perforations in paper tape, IBM cards, and, finally, long rows of numbers on paper tape. As soon as scientists have had time to study and interpret these numbers, the readings of the spacecraft's instruments, the world will know what Mariner has discovered. ■■



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Ann Koester  
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Filers

They  
started  
in spare  
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The Koesters started sharpening saws in spare time with a Foley Saw Filer, Retooler and Setter. Here's the story in their own words, 10 months later: "We have acquired another Foley Saw Filer and for the past two months we have been in full-time operation. As we live in a small town of 150 population in farm area we use our truck to pick up saws in five nearby towns. With a family to support and plans for building to our house we had to pick up business fast and already sharpen an average of 15-20 saws a day. Business for the future looks even better as good machine filing is our best advertising."

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rolled out the zaniest Mallets on anybody's rails. For a week in 1914, 50-ton hopper cars rumbling into Binghamton, N.Y., were shunted onto hold tracks. Then one morning 250 were coupled up and shoved onto the main. In front of them squatted an unbelievable 2-8-8-2. Sixteen driving wheels were yoked under her boiler. The other eight supported her tender. Whistles screaming, the 430-ton Erie Triplex got underway with a push from two lesser Mallets 1½ miles behind.

Then for 18 thundering miles the big girl was on her own, hauling the longest train ever handled by one locomotive. It wasn't her fault that an air hose blew, dynamiting the brakes and gutting two couplers. The hoppers were dragged on to Susquehanna, Pa., in three sections—each full tonnage for an ordinary kettle.

**Turning off the gas.** Another odd-ball design did much better for the Southern Pacific. In 1909, it put two 2-8-8-2s to work tugging freight up 89 miles of twisted track that climbed 6,600 feet to the crest of the Sierras. But the full-bellied giants gassed out so many crews in the snowsheds between Truckee and Blue Canyon that the 2-8-8-2s had to be transferred out.

About the same time, the Italian State Railways developed a non-Mallet locomotive that ran backward through Alpine tunnels. The cab preceded the lethal stack exhaust, and fuel was stored in hoppers on its sides. No coal-fired Mallet could have used this arrangement, but Southern Pacific's burned oil. Because it was easy to pipe it the length of an engine, under pressure, the road drew up plans for a cab-in-fronter and ordered a batch in 1910.

No other pike ever used this strange type. But the Espee liked them. Eventually nearly 300 handled freight and passenger trains where grades were stiffest.

In the late 'teens and the '20s, Mallet boilers were wonderfully improved. Stokers became a combination of screw conveyers and steam jet that pulverized up to 20 tons of coal an hour, then blasted it

into fireboxes big enough to seat 16 diners at a banquet table.

Feedwater heaters were no longer clumsy steel-plate reservoirs, but trim cylinders placed on a locomotive's forehead. Another radiatorlike device, the superheater, took wet steam from the closed boiler section and turned it into intensely hot "dry" steam that lost little of its punch enroute to the cylinders.

With these barrels, hinged engines no longer had to be compounded. Instead, all four cylinders were fed high-pressure

CONTINUED

## PS teach-yourself chase

STARTS ON PAGE 60

O

Your answer was:

11 is not divisible by 4.

You are correct. 4 "goes into" 11, twice, leaving a remainder of 3. Since there is a remainder, we would not say that 11 is divisible by 4.

In our proof we will want to emphasize that certain numbers are **whole numbers**, i.e. not fractions. The set of whole numbers (including 0 and the negative whole numbers) is called the set of **integers**.

Which of the following numbers is an integer?

	BOX	PAGE
3.96	B	10
$\frac{1}{3}$	F	26
37	D	18

P

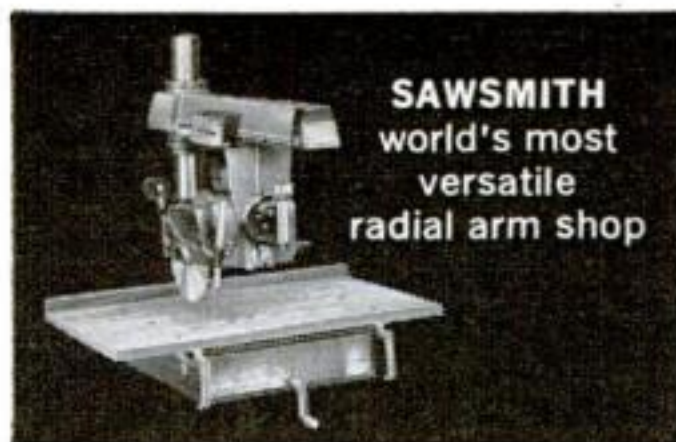
Your answer was:

No, we have not yet proven our theorem.

You are correct. We have shown that the problem of showing that  $n^2 - 1$  is divisible by 8 reduces to showing that  $m(m + 1)$  is divisible by 2, where  $n = 2m + 1$ . We showed that  $m(m + 1)$  is divisible by 2 if  $m$  is even. But we need also to consider the case if  $m$  is odd. But consider, if  $m$  is odd, is  $m + 1$  odd or even?

	BOX	PAGE
Odd	L	73
Even	AA	184



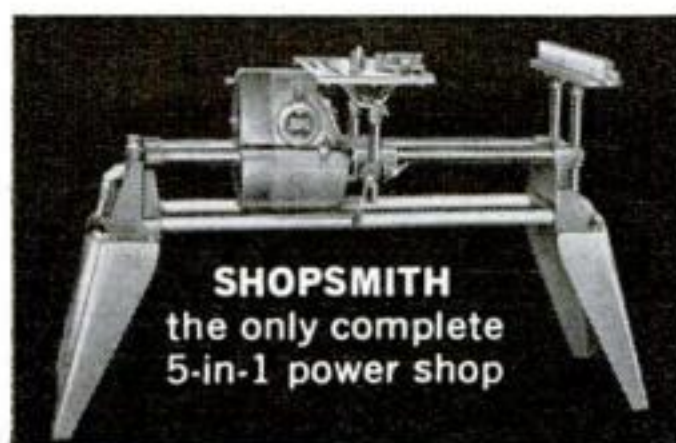


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## Those God-Almighty Mallets!

steam. Technically, such locomotives were no longer Mallets. They were "simple articulateds." But try to get a railroad man to use that handle! To the very end they remained "mallays."

*Higher wheels for faster miles.* One job remained—to adapt the monsters' running gear to constantly stepped-up schedules. As early as '28, the Northern Pacific received a batch of moderately brisk 2-8-8-4s, or Yellowstone-type locomotives, that remained the world's biggest and most powerful for 14 years. Their four-wheeled trailer trucks were a sorely needed innovation for a boiler that contained two miles of fire flues and evaporated a ton of water a minute.

The next move was to up the size of driving wheels and apply enormous roller bearings to all axles. New 2-6-6-2s, 2-6-6-4s, and 4-6-6-4s allowed tire diameters of up to 70 inches. Very little was lost in pulling power, and better terminal-to-terminal time balanced the books.

The fruit of this trend—a 2-6-6-6 Allegheny type, was unveiled by the Lima Locomotive Works two days after Pearl Harbor. She and a fleet of sister engines walked away with the heaviest coal trains the Chesapeake & Ohio had a mind to tie to their tails. There are some who say they were a match for the then two-months-old Union Pacific Big Boys. But that was never proved.

Almost as abruptly as they had entered the American railroad scene, the mighty Mallets disappeared. In 1941 there were more than 6,000, with a collective war-service record of nearly a billion miles. But aggressive little diesel units, traveling in packs, were closing in for the kill.

Mallets like the UP's Big Boys were a match for any three of the upstarts. They cost half as much to build (\$318,000 apiece) and offered no threat to our oil reserves. On the other hand, they were hard on the rails, needed elaborate terminal facilities, and were available for service only one hour out of three, as against two hours for the diesels. Ironically, too, they were outclassed at their own best game—letting one crew do the work of



### Those God-Almighty Mallets!

two. For with multiple-unit control, a single engineer could hold the reins on any number of diesel horses.

Add a no-holds-barred sales campaign, pushed by the largest manufacturer of land vehicles in the world, and the grand old free-steamers didn't have a chance. Only a few escaped the cutting torch. With empty tenders and naked grates, they stand in public parks and railroad museums. They're no longer awesome—only mute mementos of a day when a younger country worshiped bigness and said to heck with miniaturization. ■ ■

## PS teach-yourself chase

**STARTS ON PAGE 60**

**Q**

Your answer was:

Our theorem says  $(n^2 - 1)$  is divisible by 8, if  $n = 6$ .

You missed something. Our theorem is concerned only with the odd integers (1, 3, 5, 7, 9, ... etc.). The even integers (2, 4, 6, 8, 10, ... etc.) are not covered by the theorem we wish to prove.

Now return to Box D, Page 18, and choose the right answer.

**R**

Your answer was:

$$(3x + 2)^2 = 9x^2 + 12x + 4.$$

You are correct. Very good.

$$(3x + 2)^2 = (3x)^2 + (2)(3x)(2) + (2)^2 \\ = 9x^2 + 12x + 4$$

Very well, you should have no trouble now squaring  $(2m + 1)$ . Return to Box K, Page 73, and go on from there.

**S**

Your answer was:

If  $m$  is an even integer, the quantity  $m(m + 1)$  is not necessarily even.

Yes it is. You must have been thrown off by the fact that if  $m$  is even,  $m + 1$  must be odd. But the product of an even number and an odd number is even isn't it?

Now return to Box A, Page 10, and try again.



## What's so great about Delta's new 15" drill press besides the price—\$124<sup>00</sup>\*?

Just this. Delta quality features and standard Delta industrial construction. For you, it adds up to accuracy and versatility you can't match at this low price. Check these advantages:

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\*Bench model less electricals

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space vehicles—the view of stars whirling past a window of the spinning cabin might be more dizzying than helpful. Possibly, though, an observation window may later be installed in the end of the hub opposite the entrance.

Inevitably, as crewmen walk about within the station, their shifting weight will make it roll like a ship. But this “wobbling” could be kept gentle and brief by its attitude-control jets.

*To control the temperature inside*, the doughnut’s exterior will probably be given a checkered pattern of heat-absorbing black patches, alternating with others of “daylight orange”—for high visibility—or white. It will also glint with panels of solar cells, seen as the source of electric power for the first space stations’ lighting and appliances. Later stations’ bigger power plants may collect the sun’s rays with inflatable mirrors; Goodyear is building a huge 45-foot version for trial.

Like its 30-foot space station, Goodyear’s proposed 150-footer could be put up at a single launching. A Saturn rocket would do it nicely. Weighing 15,000 to 16,000 pounds, this three-spoke design would accommodate a crew of 20 to 25. Rotating at the same four r.p.m. rate as the smaller one, it would provide a full “one G” of gravity, the same as on earth. In the 30-footer, the value would be about the same fraction of a “G” as on the moon; while this should be enough, the designers think a whole “G” would be still better.

Still awaiting complete solution, Goodyear concedes, are the space-station problems of bombardment by high-speed meteoric particles, and by the perilous radiation of occasional solar flares.

Fortunately, though, most meteoric fragments are small enough to be stopped by a suitable “bumper”—and Goodyear finds a promising kind in a two-inch thickness of foam rubber, to be sandwiched between inner and outer layers of the doughnut’s fabric. In case a bigger particle should puncture the station,

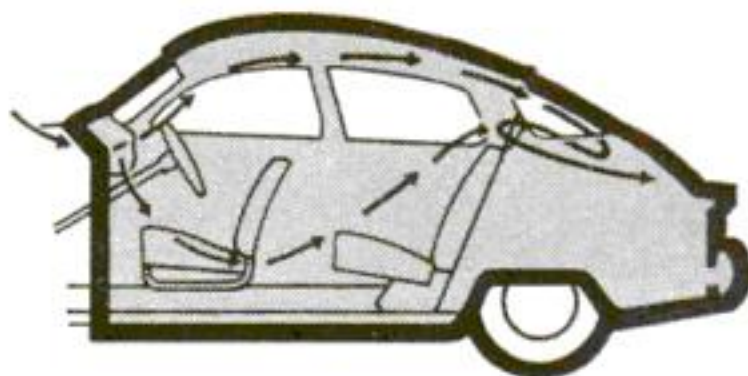
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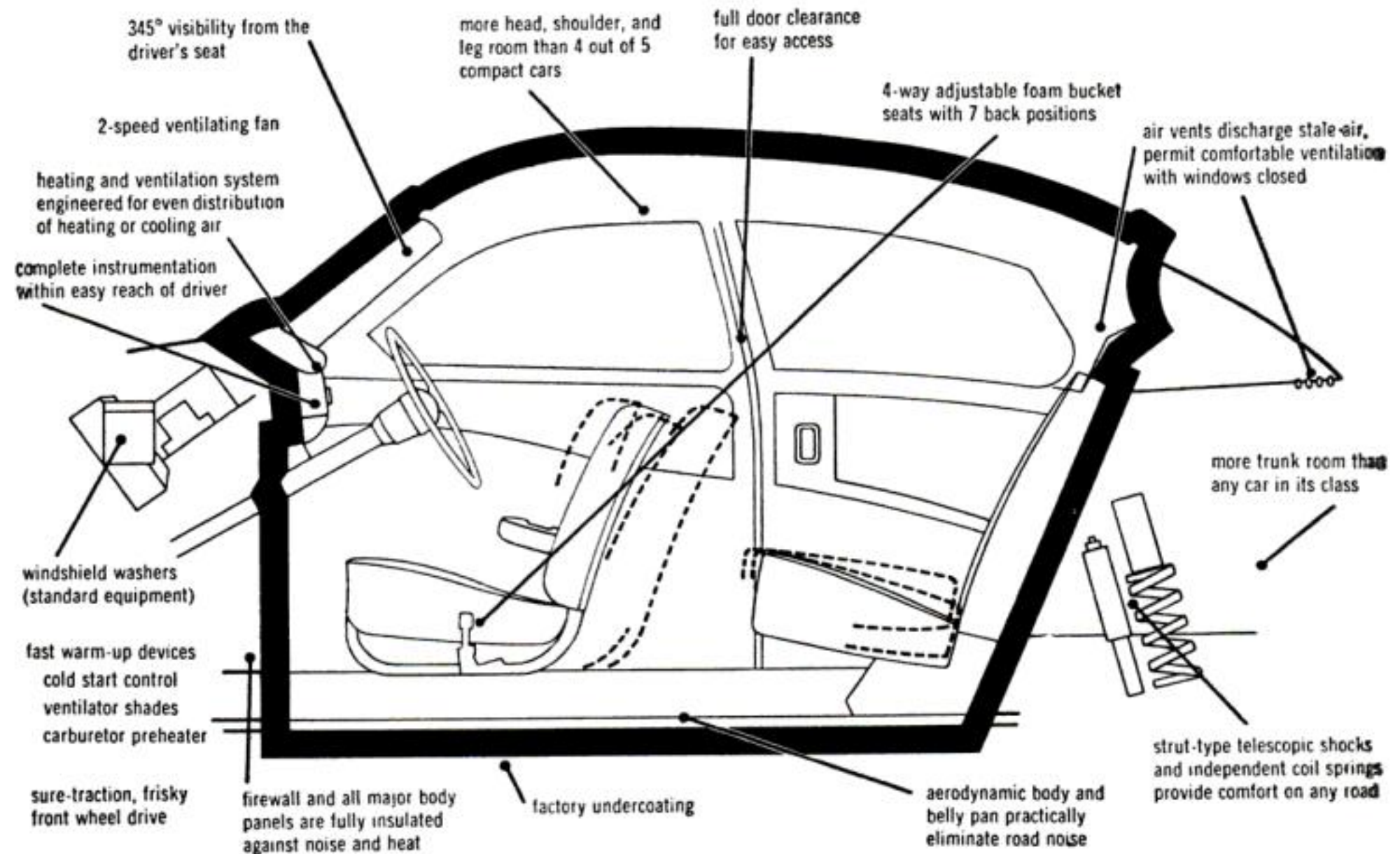
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## Inside Our First Space Station

airtight partitions will enable a leaking section to be sealed off from the rest until a space-suited crewman can mend the hole with a quick-repair kit.

A *shielded "storm cellar"* to which a space-station crew could withdraw for protection, when a solar flare was predicted, has been considered by Goodyear. But the weight of the required shielding makes its feasibility look doubtful to Paul Swanson, Goodyear's space-station project engineer. Probably, he thinks, the forewarned crew will simply have to evacuate the station and descend to earth, returning when the danger is past. Laboratory animals left aboard the station will enable them to study the radiation's biological effects.

In official U. S. space plans, space stations are having a comeback, after an eclipse of several years.

Back in pre-Sputnik days it was taken for granted that a trip to the moon or beyond would start from a space station, to avoid the fuel-draining climb through the earth's atmosphere. But putting one up, as then envisioned—piece by piece, from the payloads of dozens or scores of rockets—was so far beyond existing technology that the idea was sidetracked. National Aeronautics and Space Administration experts figured we could get to the moon sooner by the direct-from-earth Apollo program now under way.

Inflatable designs for "one-shot" launchings have put space stations back in the running. At its Langley Research Center in Virginia, NASA has been testing a 24-foot hubless version of Goodyear's doughnut—and studying, with toy-size models, an alternative inflatable design, of tubular metal sections. The Air Force is reported interested, too. While neither agency yet has funds to build a space station, it's possible that NASA may seek them next year. Meanwhile, trying its hand at its own expense, Goodyear has gone ahead to construct the first space-station-in-being.

*Modernized-style homes* in space may find uses in post-Apollo space travel, or sooner. Probably the first will serve pri-

marily as laboratories to study weightlessness, communications, life-support systems—and perhaps to test space weapons and nuclear rockets above the atmosphere. Later, space stations will be transfer points for passengers of spacecraft "shuttling" between earth orbit and the moon; as well as supply and repair depots for both manned and unmanned vehicles beyond the earth. And ultimately, they are expected to become the orbital launching pads for the huge, space-assembled rockets that will carry manned expeditions to distant planets. ■ ■

## PS teach-yourself chase

**STARTS ON PAGE 60**

Your answer was:

$$(2m + 1)^2 - 1 = 4m^2 + 4m + 1.$$

You squared  $(2m + 1)$  very nicely, but you forgot to subtract the 1.

$$(2m + 1)^2 - 1 = (4m^2 + 4m + 1) - 1 \\ = 4m^2 + 4m + 1 - 1$$

Now tidy up the expression above and then go back and choose the right answer in Box K, Page 73.

Your answer was:

If  $m$  is an even integer,  $m(m + 1)$  is divisible by 2.

You are correct. If  $m$  is even, it can be written in the form  $m = 2p$ , where  $p$  is any integer, either even or odd, and therefore

$$m(m + 1) = 2p(2p + 1)$$

which is clearly divisible by 2.

We have seen that if  $n$  is an odd integer,  $n^2 - 1 = 4m^2 + 4m$ , where  $m$  is either even or odd. We say that if we could show that  $4m^2 + 4m$  was divisible by 8, we would have proven that  $n^2 - 1$  is divisible by 8. Since  $4m^2 + 4m$  is divisible by 4, it is sufficient to show  $m^2 + m$  is divisible by 2. We considered the case where  $m$  was even, and showed that if  $m$  is even,  $m(m + 1)$  is divisible by 2; thus  $4m(m + 1) = 4m^2 + 4m$  is divisible by 8, and therefore  $n^2 - 1$  is divisible by 8. Does this prove our original assertion that  $n^2 - 1$  is divisible by 8?

	BOX	PAGE
Yes	M	166
No	P	170



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*Then I saw her whole ugly hull* as I drew near. It was splashed with red lead in what seemed hit-or-miss fashion, as if a small boy had cut loose with a paint brush. Flip looked for all the world like two welded sections of cross-country pipeline, the rear portion fatter than the front one. Actually, the sternmost 150 feet of hull is 20 feet in diameter, the forward section 12½ feet in diameter. They are linked by a 90-foot flaring collar of high-strength steel.

I went aboard with Dr. Fred Fisher, one of three Marine Physical Lab physicists who helped design Flip. He's a rugged young ex-tennis player, a lot more agile on ship's ladders than I am. Flip's ladders would confuse anybody, though. Some are vertical, some horizontal, so as to be useful whatever the craft's attitude.

Looking inside the prow, whose four compartments are decks when Flip has flipped, made me feel as if I were visiting a fun house. We had to climb in and out of the decks, rather than walk on them, and step over "fences" that would be platforms when Flip's on end. A washstand sticking out of a bulkhead up near the ceiling set me to wondering.

"What'll you do about a head on this topsy-turvy craft?" I asked.

Dr. Fisher grinned.

"We'll bring a chemical one aboard with us when the vessel is on station. You know, nobody'll be riding on Flip when she's being towed. We'll be aboard an ocean-going tug. The tug will lug us where we want to go, and then work with us. It will take part in the sound studies, sometimes close by, and sometimes as much as 100 miles away. On station, we'll live on Flip a week or two at a time."

"Suppose the thing started to sink?"

In silent reply, Dr. Fisher pointed to an inflatable life raft, lashed nearby.

*The engine room* was next on my tour. We peered down upon two silver-colored 60-kw. diesel generators. They supply the electricity for Flip's electronic equipment, lights, air compressor, and foghorn. Soon, they'll run air conditioners, too.

"Why, they're horizontal!" I exclaimed.

"Oh, sure," said Dr. Fisher. "They're on trunnions. They pivot, so they remain in the same position whether Flip's on its keel or on its tail. See, they've got flexible exhaust tubes."

"What about the stuff that's not on trunnions?" I asked.

"Everything movable is lashed or stowed before a dive."

"How about the electronic gear?"

Dr. Fisher showed me some of that next. The knobs and dials were all arrayed at a 90-degree angle to the floor—which, of course, was really the wall.

"It doesn't hurt 'em to ride that way till we get ready to dive. Afterward, naturally, they're in the right position."

I asked about a column that threaded all four compartments of the prow. It looked like a fire pole on its side.

*"That's the optical tube.* We can look all the way down to the bottom of this beast when we're vertical. There's a source of polarized light down there. We want to keep an eye on that beam of light to see how much we're twisting."

"Can you climb down inside the hull?"

"Only 150 feet," Dr. Fisher replied.

"Down past the big air bottles—we carry 4,000 cubic feet of 250-pound air in 10 containers. That's to blow water out of the ballast tanks when we want to go horizontal for towing to a new site."

"Will you be doing any scientific experiments at the bottom of the tube?"

"No," said Dr. Fisher. "The original plan was to locate orientation motors down there, so we could turn to face waves or sounds. But at first we'll use the access tube just to go down and take the lid off the lower half of the optical tube, or put it on. Maybe some day we'll have a remote control for that, but just now we can't afford it. We had to use 112 more tons of steel than we expected. Much of this craft's skin is steel plate, one-half to three-quarters of an inch thick."

"What's it like to submerge? Pretty scary?" I asked.



## The Ship That's Built to Sink

"No sweat," said Dr. Fisher. "First we flood the stern tanks with around 500 tons of sea water. That takes about half an hour. In the process we drop at the stern only about 10 degrees. Then, in the next 100 seconds, the bow rises from 10 degrees to 90. There's no plunging or heaving, though. It's like a nice, short ride in a slow, smooth elevator."

"Don't you feel you might be going straight to the bottom?" I asked.

"Well," said Dr. Fisher with a grin, "the first time, of course, we weren't absolutely sure." ■ ■

## PS teach-yourself chase

**STARTS ON PAGE 60**

Your answer was:

If  $m$  is any integer,  $2m$  is an odd integer.

No matter what number  $m$  is, the number  $2m$  must be even, since it contains the factor 2. So the number  $2m$  is always an even number, not an odd number.

But you now have some purchase on the right answer. You know now how to write a number that is always even. What can you do to an even number to get an odd number?

Return to Box N, Page 166, and choose the right answer.

Your answer was:

How do you multiply  $3x$  by itself?

In general, if you have a term which is itself a product, such as  $ab$ , then the square of that term is the product of the squares of its factors, i.e.,

$$(ab)^2 = a^2b^2$$

If one of the factors is expressed as a numeral and the other is a literal number, as in the case of the term  $4z$ , for example, you square the numerical factor and multiply the result by the square of the literal factor. For example,

$$(4z)^2 = (4)^2(z)^2 = 16z^2$$

Now you should have no trouble squaring the term  $3x$ .

Return to Box E, Page 26, and try again.

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of it. A snowdrift catches your fancy, and you tear into it—maybe through it—and, with snow down your neck, emerge grinning like a halfwit. You spy a knoll, and at 25 m.p.h. churn over it, jumping, and landing with a bounce.

After meeting four other Ski-Doo lodge members, we followed-the-leader through the woods. Like a pack of bobsleds, we skittered and slid through tight turns, over brambles and saplings, under low-hanging branches, automatically ducking behind the windshields. The last man had a hard-packed trail to follow, and his machine practically steered itself as it followed the others.

*Only once did I get stuck.* I tried to take a hill too slowly. Without momentum, the track clawed for a footing, but the scooter wouldn't move. I felt myself sinking lower and lower in the snow. With advice from Duke, I got off—sinking to my waist again—jerked the machine's rear out of the hole it had dug, then gave the throttle a squeeze. The buggy jounced up the snowdrift, coming to a put-put halt on the crest.

Later, resting at the hunting lodge, I questioned Duke about upkeep. He's been selling the machines for three years now, and claims that aside from two broken drive belts and one worn-out track, the only replacement item has been plastic windshields—broken by low-hanging limbs.

We talked about jobs for the motorized toboggans. Most are used exclusively for sport, but they're also being put to work in a variety of ways:

- In northern Michigan, a mailman makes deliveries via Ski-Doo.
- A trapper near Saganaga Lake, Minn., easily covers his 250 square miles of trap line.
- A Nebraska farmer uses one to check his wintering stock.
- Ice fishermen in Wisconsin are getting to remote lakes, and a gas station in Grand Marais, Minn., rents Ski-Doos to winter hunters.
- A New York State timber cruiser

finds that with a Ski-Doo he can spot five times more trees for cutting than he can in summer months.

- One man's winter job: shoveling heavy snow from summer-cabin roofs. He gets around via Ski-Doo. (His business is evaporating, however; some summer-house owners now have their own Ski-Doos, use their cabins year-round.)

- And one Connecticut commuter now looks forward to heavy snow; it gives him an excuse to Ski-Doo to the morning train. ■ ■

## PS teach-yourself chase

STARTS ON PAGE 60

Your answer was:

$$(2m + 1)^2 - 1 = 4m^2 + 4m.$$

**X**

You are correct. Well, we have made some progress. We wanted to show that if  $n$  is an odd integer, the quantity  $n^2 - 1$  is divisible by 8. We expressed the fact that  $n$  was odd by writing it in the form  $n = 2m + 1$ . We now find that, with substitution, the problem of showing that  $n^2 - 1$  is divisible by 8,  $n$  being odd, is the same as showing that  $4m^2 + 4m$  is divisible by 8, where  $m$  may be either odd or even.

The number  $4m^2 + 4m$  cannot be directly shown to be divisible by 8, but it is clearly divisible by 4:

$$\frac{4m^2 + 4m}{4} = m^2 + m$$

If we can now show that  $m^2 + m$  is divisible by 2, we will have shown that  $4m^2 + 4m$  is divisible by 8, and therefore that  $n^2 - 1$  is divisible by 8. The expression  $m^2 + m$  may be easier to work with if we factor it. Which equation below is correct?

	BOX	PAGE
$m^2 + m = m(m + 1)$	A	10
$m^2 + m = m(m + 0)$	C	18

**Y**

Your answer was:

$$(3x + 2)^2 = 9x^2 + 6x + 4.$$

Tut. You forgot to multiply the second term (the 2) by **twice** the first term (the 3x).

Now return to Box E, Page 26, and try again.



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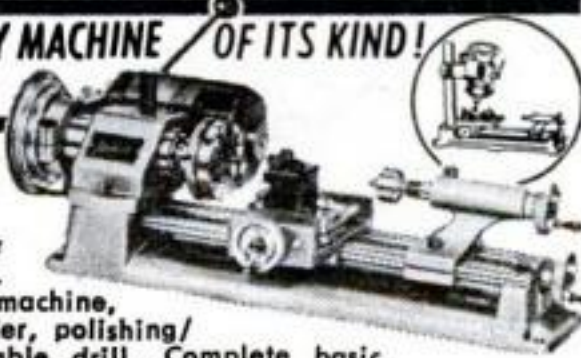
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## You Name It: This Boat's Got It!

[Continued from page 114]

a lumpy roll in the driver's normal line of vision. On the Scott, the top folds *back* and disappears behind a tilting panel. And, as if this weren't enough of a trick to justify the panel's existence, the panel itself becomes a picnic table when folded forward.

This matched and factory-assembled craft is ready to go when you get it. You're not deep into the summer, still installing the instruments you want aboard. They're all here at the start.

The dash is home to a satisfying array of needles, dials, buttons, and levers. There's a speedometer, tachometer, fuel gauge, temperature gauge, key-turn starting, shallow-water drive control, built-in shift and throttle controls, and controls for the running lights, spotlight, and horn.

**The easy life.** The foam seats are adjustable. You can sit up and take in the scenery, or lie flat for sunning or a nap. Gas tanks? You won't be lugging them in and out of this boat, for the tank is built in, and grounded. It fills through a rear-deck fill cap, and it holds 24 gallons. The boat even has a "sump pump"—with a sump in the lowest part of the hull, drained continuously with Scott's motor-attached Bail-a-Matic system.

For safety, a fire extinguisher is handily stowed near the driver's hand. And built-in foam flotation is installed under the forward deck and under the gunwales.

The hull is well worth looking at, too. Built of fiber-glass (five layers below the chine, four above) it's a softened V-bottom design with a sharply raked bow and a wide forward flare.

**The power plant.** The motor is semi-concealed under a sound-absorbing housing. But it's worth the effort to pull that housing forward and take a look at the 75-horse machine that pushes this 17.D.75 through the water at speeds over 30 knots.

One of the exciting things to study is the Scott surface-gap spark plug. This is designed to cut power loss and reduce piston damage from pre-ignition. Besides that, it lengthens spark-plug life.

Another basic difference inside the Scott engine is the oil-to-gas ratio. Instead of the usual quart of oil to five or six gallons of gas—for a 20:1 ratio—you add only a fifth as much oil, to make a 100:1 oil-gas ratio. This is, if you use Scott's special oil. With regular outboard oil, you use *half* as much



### You Name It: This Boat's Got It!

as normally—a quart of oil for every 10 gallons of gas—for a 40:1 ratio.

This motor plays other tricks, too. Its tilt-up is one. For operation in shallow water, you pull the shallow-water drive-release handle, then simply shift the engine into reverse so it will tilt up and lock into a higher position. Then you can shift back into forward and keep going—in water as shallow as six inches. To restore the motor to normal operating depth, just pull the release handle by the driver's seat. There's no special hydraulic system, no electric

motor, no extra installation. The motor does all the work.

We went reluctantly back ashore only because we still had to check the ease with which the boat could be recovered onto the trailer. It turned out to be almost as simple as launching, with the geared-down winch enabling us to haul the relatively heavy boat aboard the trailer with little effort.

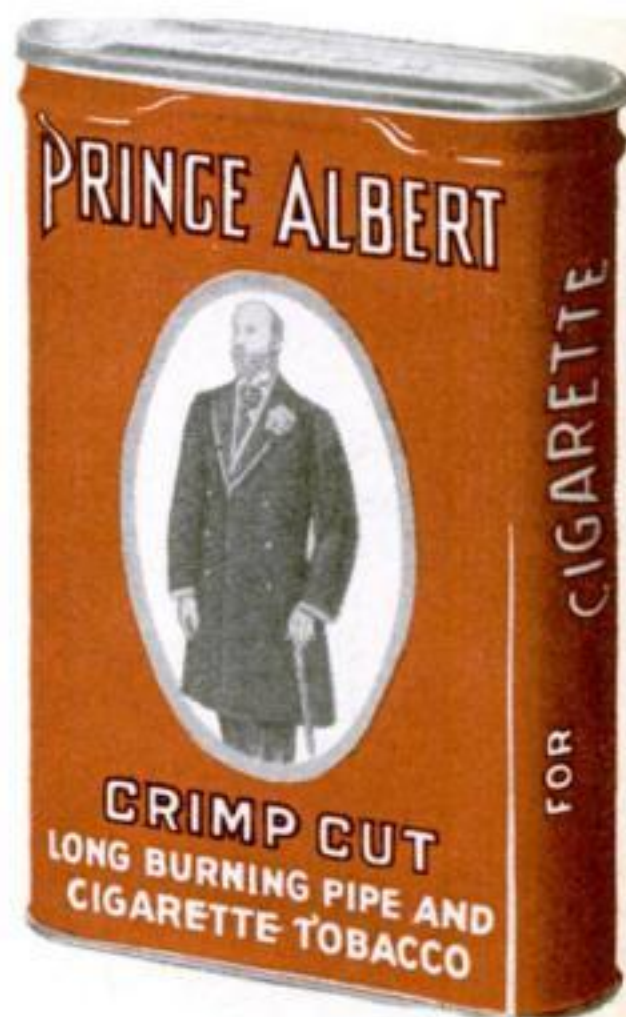
This easy job, combined with the ease of launching and the lively performance on the water, makes the Flying Scott 17.D.75 a boat that invites every-weekend use. ■ ■

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**The why of PCV.** The immediate reason for PCV is not to make your automobile engine cleaner or last longer but to cut down on smog. Smog consists mostly of various compounds of hydrocarbons (that is, of gasoline and lubricating oil), and of some nitrous oxide. Smog irritates the eyes and lungs, and can even kill crops, as indeed it does in southern California. It's a problem in all large cities.

One of smog's biggest villains is the automobile, spewing unburned hydrocarbons into the air from the exhaust pipe and crankcase. Though great sums of money are being spent on research to eliminate smog from auto exhaust pipes, a solution seems a long way off.

Smog caused by crankcase fumes is something else again, and that is what brought us PCV for 1963. PCV eliminates about a third of automobile-caused smog.

It is practically 100 percent effective in burning up blowby. That has profitable by-products for the motorist. It cuts down on engine corrosion, oil dilution, and crankcase sludge, all of which occur when cars are idling or run at low road speeds. (Under 20 miles an hour, a road draft tube is ineffective in drawing fumes from the crankcase.) Gas mileage is boosted up to 4 percent in some cases or, for a car getting 15 m.p.g., 6 extra miles from each 10 gallons of fuel. But don't count on it. Most engines show no gas-mileage improvement at all.

Detroit frankly anticipates a lot of initial trouble by owners with PCV. Last spring a California survey disclosed that while 98 percent of all new-car dealers were equipped to service the systems,

only 18 percent of service stations and 7 percent of the independent garages were actually doing such work. California has already had two years of experience with PCV. Nationally, the figures are undoubtedly even lower.

Furthermore, Detroit sadly concedes that several hundred thousand car owners—at least—will blithely ignore servicing recommendations and complain bitterly to their dealers that their cars are faulty—when all they have is blowby colic. ■ ■

## PS teach-yourself chase

STARTS ON PAGE 60

**Z**

Your answer was:

If  $m$  is any integer,  $m + 1$  is an odd integer.

I'm afraid not. If  $m$  is even, say  $m = 4$ , then  $m + 1 = 4 + 1 = 5$ , which is odd. But if  $m$  itself is odd, say  $m = 7$ , then  $m + 1 = 7 + 1 = 8$ , which is even.

Now return to Box N, Page 166, and try again.

**AA**

Your answer was:

If  $m$  is odd,  $m + 1$  is even.

You are correct. Therefore, the quantity  $m(m + 1)$  is even whether  $m$  is even or odd.

This completes our proof. We wanted to show that if  $n$  is an odd integer,  $n^2 - 1$  is divisible by 8. To prove this, we observed that if  $n$  is odd, we can write it in the form  $n = 2m + 1$ , where  $m$  is any integer, even or odd. We can then say that

$$n^2 - 1 = (2m + 1)^2 - 1$$

$$n^2 - 1 = 4m^2 + 4m = 4(m^2 + m)$$

$$n^2 - 1 = 4m(m + 1)$$

The expression on the right is clearly divisible by 4. But  $m(m + 1)$  is also divisible by 2, since either  $m$  or  $(m + 1)$  is even, and thus  $4m(m + 1)$  is divisible by 8, as we were required to show.



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1. The names and addresses of the publisher, managing editors and business manager are: Publisher, Popular Science Publishing Co., Inc., 355 Lexington Ave., New York 17, N.Y.; Editor, Robert P. Crossley, 355 Lexington Avenue, New York 17, N.Y.; Managing Editor, none; Business Manager, Eugene S. Duffield, 355 Lexington Avenue, New York 17, N.Y.

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5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscriptions during the 12 months preceding the date above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue.) 1,275,908.

(signed) Eugene S. Duffield, President

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#### The First Space-Age Saber Saw

[Continued from page 153]

trick of slowing a motor by simply reducing its voltage didn't solve the problem of maintaining power. Under load, the voltage-starved motor just slowed down further, losing its ability to work.

The silicon-controlled rectifier, one of today's valuable family of semiconductors, varies voltage to the motor by acting like an adjustable gate. You can set it to run the motor at any desired speed. What makes the difference, however, is that the gate is regulated by feedback voltage from the motor. This voltage, induced by the spinning armature, remains constant only so long as the armature turns at the same speed. As soon as the motor starts to slow down under a load, the feedback voltage drops, and the rectifier gate opens wider to feed more voltage to the motor.

The increased voltage keeps the motor operating at the same speed so there's no loss of power. This is why you can throttle down to 1,000 cutting strokes and chew through cast iron with the same power with which you rip through pine at high speed.

**Which speed for what?** We decided to give the saw a try ourselves, and came up with some interesting results. The accompanying chart, based on actual tests, gives you an idea of the many materials that can be cut and the time it takes for each.

In some cases, you'll find the cutting times compared for different speed settings. This is where you can really see the importance of variable speed. Take steel rod, for example. Note that while you *can* cut it at high speed, you can actually cut it *faster* at medium speed. Reason: The blade teeth get a better bite at the lower speed and scoop out bigger gobs of metal.

Note also that there is often very little difference in cutting time between high and medium speeds or between medium and low speeds. This is an important tipoff to cutting quality. Where there's only a few seconds' difference, you're generally better off to choose the lower of two speeds. Your control is better, blades are subjected to less heat and last longer, and you usually get a smoother, cleaner cut.

What does not show up in the chart is the sheer ease of cutting you get by combining different speeds with various types of blades. With a fine-tooth blade at medium speed, you can hold a tin can in your hand and slice it like a salami.



### The First Space-Age Saber Saw

At low speed, the blade walks right through stainless-steel counter trim, always a tough customer. With a special toothless knife blade, you can cut soft materials like rubber and leather as if you were using a pair of scissors.

For delicate veneers and plastic laminates, there's a 10-tooth tapered blade with no set to its teeth. This gives you, in effect, a hollow-ground blade for fine cutting without chipping and splintering. For thick stock, there's also a 6" coarse-tooth blade. It can handle 4" timbers and fireplace logs up to 5½" thick.

**The nice touches.** Besides the multispeed drive, a good bit of thoughtful engineering has gone into the new Sears saw. There's a removable clear-plastic guard surrounding the blade that stops chips from spitting into your eyes without blocking your view of the cut.

A holder for spare blades, the first we've seen, clips right to the power cord where it can't be lost. Another holder keeps the blade-changing wrench handy. If you break a blade, a convenient recess in the chuck lets you reach in and flick out the stub.

The saw's baseplate is pivoted and can be tilted to any angle up to 45 degrees for making miter cuts. Maximum cutting depth with standard 3½" blades is 2¾" at 90 degrees and 1" at 45. The 4.1-amp motor is geared down 7.4:1 at the blade and is said

	MATERIAL	CUTTING TIME (seconds)	SPEED USED	NO. OF BLADE TEETH
WOOD	¾" plywood (per ft.)	17	med.	7
	¾" plywood (per ft.)	12	high	7
	2" x 2" mahogany	19	high	10
	2" x 6" softwood	28	high	10
	4" x 4" softwood	104	low	7
	4" x 4" softwood	85	med.	7
	4" x 4" softwood	53	high	7
METALS	⅝" steel rod	81	low	24
	⅝" steel rod	47	med.	24
	⅝" steel rod	77	high	24
	½" x ½" steel bar	59	low	32
	½" x ½" steel bar	55	med.	32
	1¼" stainless-steel counter trim	8	low	32
	½" galv. pipe	32	med.	32
	1" copper tubing	31	med.	32
	1" copper tubing	21	high	32
	1" brass tubing	25	low	32
	1" brass tubing	19	med.	32
	1" brass tubing	18	high	32
	1" aluminum tubing	8	low	32
	1" aluminum tubing	5	med.	32
SPECIAL MATERIALS	1¼" plastic tubing	9	low	32
	½" drywall (per ft.)	8	med.	10
	½" drywall (per ft.)	7	high	10
	⅛" temp. hardboard (per ft.)	8	med.	10
	⅛" x 9" x 9" asphalt tile	21	high	24

CONTINUED 187

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## The First Space-Age Saber Saw

to develop 1/2 hp at any speed setting you use.

It's refreshing to find a manufacturer who does *not* tell you glibly that a tool has been lubricated for life at the factory and needs no further attention. In most cases, this is wishful thinking. Instead, the Sears people frankly advise occasional lubrication for best operation and longer life. What's more, they've made it easy to do. You just unscrew the knob on top, squirt in a bit of gear-case grease, and that's that.

Two accessories to become available soon will enable you to mount the blade out in front of the baseplate or to either side of it. With these, you'll be able to make flush cuts right up to walls and other obstructions without the baseplate getting in the way.

*Any weak points?* Not many. We personally would have preferred a continuously variable speed selector to the three-step switch provided. This would give you even greater flexibility in suiting blade speed to the material. Sears' argument against it is that there would be more chance of accidentally operating at an incorrect speed. With the step switch, you always know you're on one of three definite speeds. Well, Sears has a point here. Also, a continuously variable speed control would undoubtedly have added somewhat more to the cost of the tool.

One minor quibble: The baseplate can't be tilted for angle cuts with the big 6" blade because the slot isn't large enough to clear the wide blade shank. Since this is the only blade long enough to make angle cuts in 2" stock, it means the miter feature is limited to about 1" stock. You don't often have to miter a two-by-four, but it would be nice to be able to.

All in all, the Sears saw is one of the hottest new tools we've seen in a long time. Its price—\$49.95—includes blades, a rip guide, and a circle-cutting attachment. In addition to home-shop uses, Sears expects the saw to become a welcome workhorse for professionals, too.

Consider the carpenter, plumber, electrician, heating contractor, and appliance installer all carrying a single tool that will gleefully tackle pipe, conduit, thin sheet-metal ducts, heavy joists and rafters, linoleum, floor tiles, wall materials, and—you name it.

That's saying a mouthful—and we're inclined to agree. ■ ■



## How to Stay Friends with a Fireplace

[Continued from page 146]

to clear it. Or you can do the job by going to the roof and lowering and raising a tire chain on a rope. Remove the soot through the basement clean-out door.

**Downdraft.** Cold air sometimes comes down the flue with enough force to counteract the updraft of warm air.

This last reason for a smoke-filled living room may be very simple to correct—or it may be a little difficult.

First, try the old trick of "drawing up the fire." To do this, you take a double sheet of newspaper and hold it over the fireplace opening, about six inches up from the hearth.

Now three things happen. First, the size of the opening is reduced temporarily in relation to the size of the flue. Second, the air drawn into the fireplace is accelerated and arrives directly at the base of the fire. Third, the throat of the fireplace is made effectively deeper so that the smoke is captured and finds its way out.

Once this trick has established a rushing draft and produced good flames, smoking will stop unless there are deeper problems.

**Minor changes improve a fireplace.** Nearby buildings, your own roof, or trees (which can grow up and turn a previously well-behaved fireplace into a monster) are often the cause of smoking. They deflect breezes down the chimney. You can often cure this by adding a few courses of brick. Two feet above nearby roofs is the rule, and you can make the addition safe with a proper wind cone. It's a simple matter to put a wooden form around the chimney top and trowel a concave bevel of concrete mortar up to another form inside the chimney. Reinforcing wire at the corners assures a permanent job.

Actually, a certain amount of downdraft is inevitable in any fireplace. If you investigate how a fireplace is built, you can see how the smoke shelf catches the current of cold air and deflects it into the stream of heated, rising air. If a smoke shelf is too narrow, the downdraft may pass it and carry smoke into the room. That's why there is always an ideal position for the damper as an antismoke device, regardless of its fundamental job of preventing heat loss up the chimney. In some positions, the damper supplements the efficiency of the smoke shelf and stops smoking instantly. ■ ■

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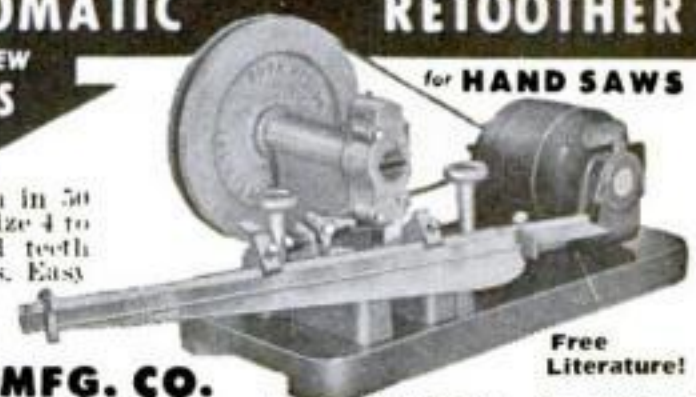
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## Blizzard Busters of Berthoud

[Continued from page 52]

cornered faster. Then a dial tells Hicken the rear wheels are in line again, and he locks them.

Most rotaries use auger blades that must be rammed repeatedly against deep snow. But No. 1500's thin steel helical blade is cutting clean as a knife in cheesecake. Once, somewhere over the 10,000-foot-high Moffat railroad tunnel, we hit a concrete post. It just goes up that jet as a cloud of dust.

Then we plunged into a road closed for weeks by hard snow eight feet deep. "Not even V-plows could bust through this stuff," Hicken says, "and good time for a rotary would be 2,500 feet an hour." We shudder through five times that fast.

Our big jet of snow is arcing 30 feet high above the road. Suddenly it is full of ice, thousands of small chunks flying up.

"Look back," Hicken says.

The road behind us is black and bare. Not a trace of snow pack or ice remains. Hicken had activated two hydraulic rams. These, pressing down on the rotor with a three-ton weight, have squeezed it hard against the road. The notched blades are stripping tons of ice packed by traffic and frozen by sub-zero nights.

"No blade plow," Hicken says, "could ever do a job like that."

The high white jet screams. We cross the great top plateau. It used to take seven hours to open Berthoud Pass. This monster goes through—the full 24-mile round trip—in 90 minutes.

Down from the high passes, I fly East. Hours later I am skidding my car over miserable ice on badly plowed Route 44 in New York State and the radio is proclaiming snow tie-ups in Nebraska, Iowa, Illinois, and Virginia.

After what I've seen in Colorado it seems almost ludicrous. Colorado is showing that massive delays—and costly smashups that add millions to insurance costs in every snowstorm—are inexcusable. "Instant plowing" needs to be copied by states and cities everywhere. ■ ■



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# POPULAR SCIENCE OPPORTUNITIES

**EARN** Money raising fishworms for us! Write: Oakhaven-42, Cedar Hill, Texas.

**MAKE** Money Making Leathergoods 1148 Ideas, Free Information, Tandy Leather Co., Box 791-N3, Fort Worth, Texas.

**\$100.00 WEEKLY** spare room. Raise redworms odorless, soilless way. Charlie Morgan, Box 116-C, Bushnell, Florida.

**OPERATE** profitable mail order business. Write Walter Service, 4159-B East 112th, Cleveland 5, Ohio.

**MAKE** Telephone Surveys spare time! Free Home-Business details. No selling, choose your own hours. Telephone Institute, Dept. HCPC, 1038 So. La Brea, Los Angeles 19.

**MAKE** extra money. Big steady earnings, repeat business. Sell advertising Book Matches, full or part time. New 1962 line. Show Glamour Girls, Colorama, Tenorama; dozens more. All sizes. Free Master Outfit, sales helps, leads, no experience necessary, no investment. Write today. Superior Match, Dept. PX 1262, 7530 Greenwood, Chicago 19.

**BRONZE** Baby Shoes. Genuine Electroplating process. Equipment, Mountings, Instructions. Send \$1.00 for Valuable Book "Your Guide To Success" Bronzing Baby Shoes, plus complete catalog. Hollywood Bronze Supply, Dept. B70, 3445 Union Pacific Avenue, Los Angeles 23, California.

**BUY** Direct From Factories—Appliances, Cameras, Watches! Free details! Cam Company, 436PS Bloomfield Ave., Verona, N. J.

**FREE** Literature — Make Big Money Raising Fishworms and Crickets. Carter Farm, Plains, Georgia.

**\$200 WEEKLY** Selling Books By Mail. Box 51-R, Des Plaines, Illinois.

**WANT** Your name with 1000 mailers? 25c lists your name with our mailings every month, Dixie Mailers, King, N. C.

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**STOP** Throwing Away Boxtops! They're worth money! Some, 25c! Inquire: "Box-tops-DG", Cedar Hill, Texas.

**FREE** Report "609 Odd, Successful Businesses." Box 1001-H, Evanston, Ill.

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**MAILORDER** Catalogs—No inventory required. Full profits. Operate from home. Send 25c for 32-page sample catalog featuring 150 unusual fast-moving products and complete details. Satisfaction guaranteed. Gaylords, North Adams 7, Mass.

**JOIN** Dollars Unlimited Club. Big Profits. Box 2766A, Kalamazoo, Mich.

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**LEARN** to sharpen, repair, and service lawn mowers, also straighten crank shafts intact. Wirt's, 2419 Gnahn, Burlington, Iowa.

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**SELL** Champion, AC, Autolite spark plugs. Precision reconditioned, electroplated, guaranteed 10,000 miles. Up to 308% profit. Free samples. Indy 500 Spark Plug Co., Plant 2, 4620 N. Braeswood, Houston 35, Texas.

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**HOMEWORK**. \$1 brings list of companies offering homework. Eagle, Box 135, Bronx 60, N. Y.

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**BAKE** New Greaseless Doughnuts In Kitchen. Sell stores. Free recipes. Summers, 3605 South 15th, Minneapolis 7, Minnesota.

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**MINK Raising** information free. Complete. Lake Superior Mink Farm, Superior EE, Wisconsin.

**\$50.00 DAY** part time bait business. send 50c for complete setup, details. E. W. Douglas, 766a St. Clair West, Toronto 10.

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**MAILORDER—Get \$4.00 Orders—Keep \$4.00.** Sample, Details, Offers full Year, \$1.00. Rorick's, Cincinnati 26, Ohio.

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**SPLIT Leather Wallets.** 1 Doz. \$5.95. Sample \$1.00. Edward Silverman, 148 Osborne Terrace, Newark, N. J.

**MEN, Women!** Turn spare time into cash! Taylor Enterprises, Export, Pennsylvania.

**BECOME A Notary Public!** Win extra income, prestige, business contacts. Details free. Stationers Exchange, Box 552-S, Kermit, Texas.

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**START** Your Own Business On Credit. Your own boss. 1199 Dealers sold \$5,000 to \$25,000 in 1961. We supply stocks, equipment on credit. 200 home necessities. Sales experience unnecessary. Pleasant, profitable business backed by world-wide industry. Write Rawleigh, Dept. L-U-PSC, Freeport, Ill.

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